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(54) Title: MOBILITY SUPPORT DEVICE 			
(57) Abstract <p>A mobile support device (10) for a handicapped person and rollable on a reaction surface, the mobile support device (10) is disclosed comprising first and second substantially parallel planar frame sections (34, 36) oriented in spaced relationship to define a region therebetween, the lower portion (34a, 36a) of said frame sections (34, 36) defining a base, a back support portion (16) spanning the region and coupled with the first and second frame portions (34, 36), a seat (14) spanning the region with at least a front portion thereof pivotable relative to said first and second frame portions (34, 36) and a wheel assembly (24) mounted on said base so as to engage the reaction surface.</p>			

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## MOBILITY SUPPORT DEVICE

The present invention relates to mobility aids.

With the steadily increasing geriatric population and the subsequent number of geriatric care facilities, there has been an increasing awareness of rapid emotional and physical deterioration of their residents due to, among other things, a loss of their independence. A large portion of these residents spend extended periods of time confined to their beds or chairs, and thereby need constant assistance from attending nurses to satisfy their everyday needs.

This loss in independence is not only seen as a cause for discomfort to the patient and shorter life span, but also results in substantially high costs, associated with the large skilled labour force needed to provide daily care.

It would therefore be desirable both to the patients and the administrators of the facilities in which they are resident, to provide as much independence as possible to the patients. A significant factor to independence is the mobility of the patient, which is conventionally provided by wheelchairs and rigid frame structures commonly known as "walkers".

Although providing a certain degree of mobility to the patients, there are several disadvantages associated with such mobility aiding devices. Conventional wheelchairs are bulky and provide a convenience only to those patients with a relatively

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high degree of arm strength. Those patients who have lost strength in their arms must again demand assistance from the attendants to move from one location to another.

Conventional walkers appear in two forms, one of which requires the patient to displace the structure forwardly before each step is made and is satisfactory only to those patients with sufficient strength in both the legs and the arms.

Alternatively, walkers are available providing bodily support to the patients. However, such devices are often large and bulky and require the patient to be entrapped within the structure, resulting in a mobility aid which, although assisting the patient, is conspicuous and therefore detrimental to the patients emotional well-being.

Accordingly, it is the object of the present invention to provide a novel form of mobility aid.

Briefly stated, the invention involves a mobile support device for a handicapped person and rollable on a reaction surface, the mobile support device comprising:

first and second substantially parallel planar frame sections oriented in spaced relationship to define a region

therebetween, the lower portion of said frame sections defining a base;

a back support portion spanning the region and coupled with the first and second frame portions;

a seat spanning the region with at least a front portion thereof pivotable relative to said first and second frame portions; and

a wheel assembly mounted on said base so as to engage the reaction surface.

Further features, objects and advantages of the present invention will be evident from the following detailed description of preferred embodiments, given by way of example only, as seen in the appended drawings in which:

Figure 1 is a perspective view of a mobility device;

Figure 2 is a side view of the mobility device, shown in Figure 1, in another configuration;

Figure 3 is a side view of the mobility device shown in Figure 1 in an alternate configuration;

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Figure 4 is a plan view of the mobility device in Figure 1;

Figure 5 is a plan view of the device shown in Figure 1 with an alternative portion;

Figure 6 is a partly exploded view of a portion of the mobility device shown in Figure 1;

Figure 7 is a cross-sectional view taken on line 7-7 in Figure 6;

Figure 8 is a fragmentary perspective view of a portion of the mobility device shown in Figure 1;

Figure 9 is a perspective assembly view taken with respect to circle 9 in Figure 1;

Figure 10 is a perspective fragmentary view of another portion of the mobility device shown in Figure 1;

Figure 11 is a cross-sectional view taken on line 11-11 of Figure 10;

Figure 12 is a perspective view of the portion shown in Figure 10 in an alternative configuration;

Figure 13 is a perspective view of the portion shown in Figure 10 in another configuration;

Figure 14 is a perspective view of another portion of the mobility device shown in Figure 1;

Figure 15 is a perspective assembly view of a portion of an element shown in Figure 14;

Figure 16 is a partly exploded assembly view of an alternate configuration of the portion shown in Figure 6;

Figure 17 is a frontal view of the configuration in Figure 16;

Figure 18 is a cross-sectional view taken on line 18-18 in Figure 17;

Figure 19 is an exploded assembly view of several components of the portion shown in Figure 18;

Figure 20 is a side view of an alternative portion of the device shown in Figure 1;

Figure 21 is a perspective view of another alternate portion of the device shown in Figure 1;

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Figure 22 is a perspective view of an alternative mobility device;

Figure 23 is a perspective view of a portion of a alternative mobility device to the device shown in Figure 22;

Figure 24 is a frontal view of an alternative element of the portion shown in Figure 23;

Figure 25 is a side view of the element shown in Figure 24;

Figure 26 is a perspective view of an alternative portion of an element shown in Figure 24;

Figure 27 is a perspective view of another alternative portion of an element shown in Figure 24;

Figure 28 is a side view of an alternative mobility device;

Figure 29 is a front view taken on arrow 29 in Figure 28;

Figure 30 is a plan view taken on arrow 30 of Figure 28;



Figure 31 is an exploded view of a portion of the device illustrated in Figure 28;

Figure 32 is a fragmentary perspective view of one portion of the device illustrated in Figure 28;

Figure 33 is a fragmentary perspective view of another portion of the device illustrated in Figure 28;

Figure 34 is a perspective view of another portion of the device illustrated in Figure 28;

Figure 35 is an alternative to a portion of the device illustrated in Figure 28;

Figure 36 is a side view of an alternative mobility device;

Figure 37 is a front view taken on arrow 37 of Figure 36;

Figure 38 is a plan view taken on arrow 38 of Figure 36;

Figure 39 is a perspective view of a portion of the device illustrated in Figure 36;

Figure 40 is a fragmentary view of a segment of the portion illustrated in Figure 39;

Figure 41 is a fragmentary perspective view in partial assembly form of another portion of the device illustrated in Figure 36;

Figure 42 is a perspective view of yet another portion of the device illustrated in Figure 36;

Figure 43 is a perspective view of yet another alternative mobility device;

Figure 44 is a frontal view of the device illustrated in Figure 43;

Figure 45 is a perspective view of a portion of the device illustrated in Figure 45.

Referring now to Figures 1 to 17, a mobility device 10 is shown in the form of a chair having a frame 12 which supports seat 14 and a back rest 16, with the seat being inclined at approximately six degrees from the horizontal axis, and the back rest 16 inclined 15 degrees from the vertical axis. The chair has a pair of arms 18, 20 the former being pivotal and the

latter being retractable as will be described. A tray 22 is mounted on the front of the arms 18, 20 and provides a working surface as well as a protective gate and hand grip. In addition a carrying hamper 23 hangs from the arm 20 for carrying magazines or other articles. A wheel assembly 24 is provided on the bottom of the chair which is controlled by a pair of braking handles 26 which activate a braking mechanism 28 as will be described. A pair of adjustable foot rests 30 are mounted on the frame 12 as will be described, with restraint being provided to the user by a seat belt 32 extending from the seat. As well, the seat is pivotable and height adjustable as will be later explained.

The frame is formed from left and right frame sections 34, 36 both being of a "S"-shaped configuration. Each of the left and right frame sections have a lower horizontal portion 34a, 36a to support the wheel assembly, a lower corner portion 34b, 36b to support the foot rests 30, a middle portion 34c, 36c to support the seat 14 and back rest 16, and an upper portion 34d, 36d to support the tray 22 and also to form the arms 18, 20 of the chair. As well, the middle portion 34c, 36c serves as a location for frame disassembly, as shown in Figure 3. This is provided by way of the middle portion being formed from two parts, a first segment, for example 34e, having a swaged end of reduced diameter for telescoping engagement with the end of a second segment 34f.

Referring to Figure 4, each of the arms 18, 20 is also provided with a pair of arm rests 42, while the tray 22 is pivotally connected to the left arm 18 and releasably positioned on the right arm 20. As well, the lateral edges 22a of the tray are concave thereby providing sufficient area for a working surface while enabling the patient to grip the central region of the tray 22 with his hands.

As is seen in Figure 9, the right arm 20 is easily retractable, and is formed from first and second right arm portions 20a, 20b the first portion 20a having a swaged end region for telescoping engagement with the end of the second right arm portion 20b. A restraint mechanism 44 is provided in the first right arm portion 40a and is seen as a ball 44a nested in a hole 20c and biased therein by way of a compression spring, 44b with the ball extending from the hole so as to extend into a hole 20d formed in the second right hand portion 20b.

While the right arm 20 is retractable, the left arm 18 is pivotal between a usable position and a storage position. As seen in Figure 10, the left arm 18 has a first left arm portion 18a pivotally connected to a second left arm portion 18a at a pivot connection identified at 45. In forming the pivot connection 45, the end of the first left arm portion 38a is collapsed to form a substantially "U"-shaped cross-section. As

seen in Figure 11, the first left arm portion 18a is pivotally connected to the second left arm portion 18b by way of an extensible pivot member 46 extending through co-axial bores 18c, 18d formed in the first and second left arm portions 18a, 18b respectively. The extensible pivot member 46 is formed from a cylinder element 46a closed at one end by a first head 46b with the other end having a bore 46c extending there-through. A piston 46d is slidably engaged with the inner surface of the cylinder element 46a and is joined to a shaft 46e which extends through the bore 46c, with the free end of the shaft terminating at a second head 46f. A compression spring 46g is located within the cylinder element 46b to bias the piston 46d against the first head 46b, such that rotation of the first left arm portion 38a causes separation thereof from the second left arm portion 38b, and causing the pivot member 46 to extend through the travel of the piston 46d along the cylinder element 46a against the spring 46g.

The pivot connection between the first and second left arm portions 18a, 18b and pivot connection between the tray 22 and the first left arm portion 18a enables the left arm 18 to be rotated to a convenient storing position as demonstrated in Figures 2, 10, 12 and 13. As is shown in Figure 10, the tray 22 is first rotated to a vertical position as seen by the arrow "A". The first left arm portion is then rotated to an upper

vertical position as seen by arrow "B". This is followed by the tray being returned to its original position relative to the first left arm portion as seen by arrow "C". Subsequently, the arm is rotated to a lower stored position as seen by the arrow "D". In this manner, the configuration embodied in the left arm 18 enables the patient to store the tray thereby providing the patient with the capability of sitting at a table, or of accessing the chair from the side.

Similarly, the first right arm portion 20a is easily retractable by depressing the ball 44a through the hole 20d and subsequently removing the swaged end of the first right arm portion 20a from the second right arm portion 20b.

Another particular feature of the chair 10 is the wheel assembly 24 as seen in Figure 1 which is coupled to the lower horizontal portions 34a, 36a of the left and right frame sections 34, 36. Three wheels, for example wheels 48, 50, 52 are used on each of the lower horizontal portions, for example 34a, the front and rear wheels 48, 50 thereof providing a swivel movement with respect to the lower horizontal portion 34a. The middle wheel 52 on the other hand is constrained to rotation about an axis perpendicular to the lower horizontal portion 34a. In this configuration, the wheels prevent lateral displacement of the chair relative to the floor while permitting

increased stability and improved directional tracking, as well as the ability to rotate about a fixed point.

The braking assembly 28 is shown in detail in Figure 8. The brakes are manually controlled by braking levers 26 which extend upwardly and forwardly from slots 54 formed in the rear of the lower horizontal portions 34a, 34b. Each of the levers 26 are coupled to a first link 56 which is fixed to one end of a pivot rod 58 defining a pivot axis "E", which in turn is rotatably mounted at both ends to the horizontal portions 34a, 34b. In this fashion, rotation of one first link 56 causes rotation of the other. The pivot rod 58 conveniently extends in a concealed manner within a spanner member 60 joining the left and right lower horizontal portions 34a, 34b.

The first link 56 is pivotally connected to one end 62a of a second link 62 at a pivot identified at "F" which extends along the inner cavity of the lower horizontal portion 34a, with the opposite end 62b being pivotally connected to one end 64a of a braking link 64. The lower portion of the braking link extends downwardly to a pivot pin 66 on which the braking link pivots relative to the lower horizontal portion. The braking link extends past the pivot pin and outward from a slot 68 formed in the lower region of the horizontal portion 34a. Joined to the other end 64b of the braking link 64 is a brake

pad 69 of an arcuate shape so as to contact the floor contacting surface 53a of the center wheel 53.

Thus, when either of the levers 26 is rearwardly displaced, the first link 56 rotates about the pivot rod 58 causing the second link 62 to be displaced forwardly. This in turn causes rotation of the braking link 64 about the pivot pin 66 to engage the brake pad 69 with the floor contacting surface 53a of the wheel 53.

In this manner, the braking assembly 28 provides simultaneous braking of both left and right centre wheels 53 by rotation of either braking lever 26. In addition, the pivot points are selected in the first link such that the pivot point "F" of the second link is "over-center" with respect to the pivot axis "E" of the pivot rod 58. In this manner, the braking assembly 28 provides a self-locking mechanism whereby the braking lever 26 is rotated toward contact with the rear edge of the slot 54. This corresponds to a point where the pivot point "F" is located above axis "E", thereby causing the reaction force, exerted by the wheel 54 and transmitted through the mechanism 28, to maintain the lever 26 in the locked position against the rear edge of the slot.

In an alternative embodiment, the braking mechanism 28 is capable of providing a constant light braking force to the



middle wheels for a controlled substantially unaccelerated travel down an incline. This is provided by an arcuate bracket 70 which is fixed to the lower horizontal portion 34a of the frame adjacent to the central region of a brake lever 26. The bracket 70 has a number of notches 70a formed therein to enable the lever 26 to be locked in a particular orientation so as to provide a constant braking force against the wheel 53. In this case, the extent of rotation of the lever 26 to maintain substantially unaccelerated travel, increases with the degree of incline being traversed. If desired, the pivot rod 66 may be located on the frame 53b of the wheel rather than on the lower horizontal portion 34a, thereby providing relatively shorter distance of travel of the brake pad 69.

The chair is also provided with a seat 14 which is pivotal and height adjustable by way of a height adjustment mechanism 74 illustrated in Figures 6 and 7. The seat is pivotally mounted via a pair of first support blocks 76 to a tubular shaft 78, the shaft being held at each end by a second support element 80. Adjacent the second support element 80 is a rack element 82 of a rack and pinion arrangement, the pinion 84 being fixed to a rod 86 which extends through a slot 80a formed in the second support element 80. Both the second support element 80 and the rack element 82 are fixed to a transverse frame element 88.

Positioned adjacent the second support element is a plate element 90 having a centrally located bore 90a, through which the rod 86 extends. In addition, a pair of guides 92 extend downwardly along the inner surface of the plate so as to engage with the front and rear edges 80b, 80c of the second support element 80. Fixed to the end of the rod 86 is a knob 94 for rotation of the rod 86 and accordingly the pinion 84 along the rack element 82. The region of the rod 86 between the knob 94 and the plate 90 is threaded to engage threadably with a release latch 96, which releasably maintains the rod 86 in position.

The height adjustment mechanism provides facilitated adjustment of the seat 14 relative to the frame 12, by way of rotating the release latch 96 and subsequently turning the knob 94. This causes relative displacement between the rack element 82 and the pinion 84, and results in the support element 80 travelling along the guide 92.

A further mechanism is provided on the seat to dampen sudden rotations of the seat relative to the shaft. In Figure 7, an air cylinder 98 is joined to the central region of the rear of the seat 14 and to a support frame 100 which includes an arm 100a extending rearwardly from the transverse frame member 88 and a brace 100b joining the arm 100a with the shaft 78.

In this manner, the dampening of rotation of the seat 14 is provided at any elevation thereof. With this assembly, forward movement of the patient from the back of the seat causes an immediate rotation of the seat 14 about the shaft 78, with the rotation being maintained at a slow rate by the air cylinder 98. If the patient further wishes to propel the chair along the floor, he may do so by continuing to rotate the seat 14 until his feet are in contact with the floor.

Another embodiment is shown in dashed lines in Figure 6 wherein the seat is pivotally mounted on shaft 86 by way of support blocks 102 in lieu of support blocks 76 and shaft 28. In addition, the rack element 82 and the support block 80 are fixedly mounted to plate element 90 while shaft 86 is displaced relative to plate 90 by extending through a slot 104, thereby eliminatintg the need for guides 92 and transverse frame element 88. As well, a support frame 106 is pivotally mounted on shaft 86 in lieu of support frame 100. In this case, support frame 106 includes a support block 107 pivotally mounted on the shaft 86 adjacent each pinion element 84. Projections 108 extend from the upper and lower portions of support block 107, adjacent to but not contacting the teeth of pinion 84, and extend through the slots 80a. In this manner, support block 107 displaces in concert with the rod 86 but does not rotate therewith. Extending rearwardly from each of the support blocks 107 is a

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frame member 109 which terminating at a junction with a frame member 109a which extends toward connection with the air cylinder 98.

In yet another embodiment, a tension spring 97 is located adjacent the air cylinder 98 to bias the seat to its rearwardly inclined position.

In a further embodiment, a rotation limit device 99 is located adjacent the air cylinder 98 to restrict the rearward and forward rotation of the seat to the desired six degrees with respect to the horizontal. The limit device includes an elongate element 99a having a slot 99b which is connected to the rear portion of the seat. A member 99c with a pin 99d is coupled to the arm 100a.

The chair is also provided with adjustable foot rest 30 as are shown in detail in Figures 14 and 15. The foot rest 30 includes an angular member 110 having a shaft 112 connected to one end 110a. A foot pad 114 is pivotally connected to the shaft 112 for movement between a horizontal position and a vertical position. Magnets 116 are further provided both on the foot pad 114 and the angular member 110 to maintain the foot pad 114 in a vertical position. The angular member is in turn joined to the lower corner portion 34b by a wing nut 115, and

maintained in a given orientation by a pair of interconnecting discs 116, 118.

As seen in Figure 15, each of the discs have transversely extending triangular teeth 120 which mesh upon engagement of the discs 116, 118, with the disc 116 being fixed to the angular member, and the other disc 118 being fixed to the lower corner portion 34b. The discs 118, 116 are also respectively provided with a pin 122 and recess 124 as shown in Figure 15 to enable inter-engagement of the discs within predetermined limits, thereby preventing the foot rest 30 from contacting the floor, thereby interfering with the mobility of the chair.

An alternative foot rest 125 is shown in Figure 21 wherein a right angled member 126 extends from the inter-engaged discs 116, 119 and terminates at a crown gear element 127 rotatably mounted circumferentially thereon. The crown gear is threadably engaged with a threaded rod element 128 which includes an elongate rectangular projection 128a extending along the shaft to engage with a complimentary recess on the inner edge of the member 126. The foot rest 125 is further provided with a pinion element 129 rotatably mounted to the right angled member 126, teeth 126a of which are meshed with the teeth 127a of crown gear 127. A knob 129a is also fixed to the pinion

element 129 so as to enable the user to cause rotation thereof, which in turn causes the crown gear 127 to rotate and the threaded rod 128 to be displaced relative to the member 126. In this manner, the length of the foot rest 125 is easily adjustable to accommodate users with different leg lengths.

An alternative to the aforementioned height adjustment mechanism 74 of the seat is the height adjustment mechanism 129 shown in Figures 16 to 19. In this case the seat is pivotally mounted by a pair of first support blocks 130 to a tubular shaft 132, the shaft being held at each end by a second support block 134. The second support block 34 is in turn mounted to a first transverse frame member 136. Each end of the transverse frame member 136 is fixed to a slider frame 138, defined by a pair of spaced horizontal flanges 138a, 138b and joined by a vertical web 138c. The flanges have centrally located and co-axial bores 138d which receive a threaded shaft 140. Threaded on the shaft 140 is a remote sprocket 142 positioned at spaced distances from each of the flanges by upper and lower spacers 144, 146. The threaded rod is in turn held in a support frame 148, again defined by a pair of horizontal flanges 148a, 148b and joined by a vertical web 148c. In this case, each of the support frames 148 is fixed to the central region of the middle portion 34c of the frame sections.

A chain 150 passes over each of the remote sprockets to a central crank mechanism 152 located in the central region of the transverse frame member. The crank mechanism comprises a crank 154 member having an offset cranking knob 154a mounted on a cranking arm 154b. The cranking arm is in turn mounted on a shaft 156 to which a sprocket 158 is also mounted. The shaft 156 is rotatably mounted in the transverse frame member by way of releasable mounting through a bore 136a and maintained therein by a nut and washer 160. In this manner, rotation of the crank arm 154b via the knob 154a causes the chain 150 to be displaced in a manner which causes rotation of the remote sprockets 142. By virtue of their threaded engagement with the threaded rods 140, the sprockets 142 then upwardly displace with respect to the threaded rods 140, thereby raising the elevation of the seat.

Incorporated with the height adjustment mechanism 129 is an air cylinder 159 mounted at one end on the rear portion of the seat as is shown in Figures 18 and 19. The air cylinder is mounted at its other end to a frame assembly 161 extending rearwardly from the shaft 132 and the transverse frame member 136.

It should also be noted that the air cylinders 98 and 159 each provide a dampening effect to both forward and rearward

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locations of the seat. This dampending effect could also be provided in one rotative sense only or be greater in one rotative sense than in the other. Oil cylinders are also contemplated as an alternative to the air cylinders.

Also contemplated is a height adjustment mechanism utilizing a rack and pinion arrangement, wherein the rack element thereof is fixed relative to the seat frame, while the axis of pinion element is fixed on a pivot shaft displaced relative to the seat frame. In addition, the seat may be pivotally mounted on the pivot shaft.

In addition, an alternative to the aforementioned concave edged tray 22 is shown in Figure 4 wherein the tray 162 is incorporated with one arm pad, to provide an increased arm support particularly for patients having suffered from a stroke or from other causes, resulting in little strength in one arm. Also contemplated is the use of a restraint bar in place of the tray.

Also contemplated for adjusting the height of the seat is the use of a split seat 164 as shown in Figure 20. The split seat 164 includes a rear section 168 which is mounted to the middle portion 34c of the frame by way of a pair of flanges 168 depending from each side of the rear section 166, which slidably



engage with a frame plate 170 mounted on the middle portion 34c. A series of holes 170a, 170b are located near the front and rear ends respectively of the frame plate 170 and are in-line with holes 168a, 168b located in the front and rear ends respectively of the flange 168 so as to receive adjustment pins 172. A front section 174 is hingeably mounted to the rear section 166 and has on each side a downward projection 176 which abuts a cam element 178.

A second embodiment of the mobility device is shown in the form of a stand-up walker 200 in Figure 22. The walker includes a frame 202 which supports a seat 204 pivotal between horizontal and vertical positions and a back rest 206. The support includes a releasable restraint bar 208 which assists in supporting the user as will be described. A wheel assembly similar to that in the aforementioned embodiment, and identified at 210 is located in the lower end of the frame for mobility while a pair of outriggers 212 extend transversely from the frame and adjacent to the wheels as will be described.

In addition, the stand up walker 200 may also include a braking mechanism in accordance with braking mechanism 28 in the aforementioned embodiment and, in which case, is equipped with length adjustable arms 213.

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The frame structure is formed from left and right frame sections 214, 216, each of an "S"-shaped configuration, to form lower, middle and upper horizontal frame segments 214a, 214b, 214c and 216a, 216b, 216c respectively. The lower frame segments combine with a spanning member 218 which extends between the rear region of the lower segments 214a, 216a to form a base, while the upper segments 214c, 216c combine to form the left and right arms of the walker 200. Joining each of the lower and middle segments is a first vertical spanner 214d, 216d formed from a pair of telescoping elements which, joined by a bolt configuration identified at 220, so as to provide a walker 200 which may be disassembled.

Disassembly is also provided by a second vertical spanner 214e, 216e formed from a pair of telescoping elements which, joined by a bolt configuration shown at 221 may be either disassembled or length adjusted.

The restraint bar 208 is pivotally connected to the left arm 214c, while the opposite end of the restraint bar is coupled to the right arm 216c, by way of a releasable latch 222.

Projecting longitudinally from each end of the lower frame segments are collars 224 which engage with the right angled ends 212a of rectangular outriggers 212. Joining the

right angled ends thereof is a body member 212b. The collars 224 are further provided with a bore 224a which receives a pin to fix the outrigger 212 with the lower surface of the body member having an incremental spacing from the floor surface, for example one half inch. In this manner, the outrigger 212 provides a support against inadvertent tipping of the walker 200. As seen in Figure 22, the seat 204 is pivotally connected to a pair of brackets 226 immediately below the back rest 206, which in turn is mounted on a fixed cross panel 228.

The seat 204 provides a support for the patient in a partial sitting position in which, while gripping the arms 214c, 216 or the restraint bar 208 may propel the walker 200. Alternatively, the seat may be stored in a vertical position enabling the patient to walk with the support of the walker in a standing position, with further support being provided by a harness 230.

The harness 230 includes a belt 232 which extends around the central region of the user, and has a releasable buckle in the rear portion thereof. The belt 232 is joined to the arms 214c, 216c by way of four expandable belts 234, which are coupled to the arms 214c, 216c by way of releasable brackets 236.

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An alternative to the fixed outrigger is shown in Figure 23, wherein the pins are omitted from the collars so as to enable the outrigger 212 to rotate therein. In addition, a first link 240 is pivotally connected between a remote point on the front right angled member shown at 242 and a pivot point in the central region of a second link 244. The second link in turn is pivotally coupled to the vertical spanner 214d and has at its remote end, a handle 244a enabling the patient to rotate the second link upwardly in the direction of the arrow identified at "G". In this manner, the outrigger is easily retracted to a stored position, enabling the walker to pass through a doorway.

A further alternative to the fixed outrigger is an automatically extendable outrigger 250 as shown in Figures 24 and 25. The automatic outrigger 250 is formed from a first housing 252 and a second housing 254, the second housing 254 being pivotal relative to the first housing 252, which is secured to the lower frame segment 214a. Located on the first housing 252 is an activation rod 256 which is oriented at one end 256a in close proximity with the floor surface, and is slidably engaged within brackets 258 extending near each end thereof from the first housing 252. The other end 256b of the activation rod 256 is engaged with a first latch 258 which is pivotally mounted to the first housing 252 and engages a catch

260 formed on the second housing. The second housing 254 is tubular and has one end 254a through which outwardly extends a deploy rod 262, which is slidably engaged with the inner surface of the second housing. The deploy rod is also biased to an outwardly extended position by way of a spring 263, also within the second housing and engaged with a boss 262a formed in the central region of the deploy rod 262. The other end 254b of the second housing has an aperture formed therein, through which the other end of the deploy rod 262b outwardly extends in a stored position as shown in Figure 21. The end of the deploy rod is defined by a circumferential groove 262c which engages with the finger 264a of a second latch 264, pivotally mounted to the second housing 254 and biased against the groove by a spring 266.

The second latch 264 is activated by way of an abutment rod 268 which is positioned in a bracket 270 formed on the first housing 252 and adjusted to the required extension therefrom by way of a set screw 272, so as to engage the other end of the second latch 264 upon rotation of the second housing 254 with respect to the first housing 252 under the biasing force of a coil spring 276 joined therebetween.

In this manner, inadvertent rotation of the frame 12 relative to the floor causes the floor to engage with the activating rod 256, resulting in the release of the first latch

258. This causes the second housing 254 to quickly rotate under the force of the coil spring 276 to a lateral outward position, causing the second latch 264 to engage with the abutment rod 268 thereby releasing the deploy rod 262 from within the second housing 254. In this manner, the deploy rod 262 acts as an additional stabilizer to increase the lateral stability and prevent further rotation of the frame 12 relative to the floor. In addition, the angle through which the second housing 254 rotates and the relative length of the second housing 254 and the deploy rod 262, are chosen such that in the extended position, the frictional force between the inner wall of the second housing 254 and the second deploy rod 262 provides a binding reaction force, thereby enabling the housing and the deploy rod to function as a unitary support member against the force exerted by the patient against the frame 12 of the walker.

When the frame is returned to its stable position, the binding force between the deploy rod 262 and the inner surface of the second housing 254 is immediately reduced to enable an attendant to easily retract the outrigger 250 to its stored position as shown in Figure 22.

In an alternative embodiment as is shown in Figure 26, the deploy rod 278 is formed with a "T"-shaped outward end, providing additional stability while at the same time

distributing the force exerted on the deploy rod in its extended position.

In another alternative embodiment as shown in Figure 27, a deploy rod 280 has a "T"-shaped end, with one of the transversely extending arms 280a having a arm 280b extending inwardly at right angles to the transverse arm 280a. In addition, the inwardly extending arm is oriented at an angle  $\phi$  with respect to the axis of deploy rod 280, angle  $\phi$  corresponding to the angle in which the deploy rod 280 is located relative to the horizontal in the outwardly extended position. In this manner the deploy rod 280 provides further support to the outrigger in its extended position located adjacent the front or rear wheel.

In addition, any number of outriggers may be located on the side of the walker. For example a convenient combination involves the placement of an outrigger adjacent each wheel.

Alternative arrangements are also considered for the harness 230 including six or more belts 234 to provide further support to the user. Also contemplated is the use of different types of belts 230 such that the front belts have a different spring rate constant than the rear belts, thereby providing easier flexibility of the harness in one direction than in the

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other. For example, the use of a higher spring constant in the rear pair of belts enables the user to flex the harness in the rearward direction which preventing the user to flex easily the harness in the forward direction, thereby supporting the user against falling forward.

A further embodiment is illustrated in Figures 28 to 35 in the form of a chair 300. The chair has a frame 312 on which is positioned a seat 314 and a back 316, with the frame being supported by a wheel assembly 318. The wheel assembly 318 is of the same nature as those in the previous embodiments and will hereinafter not be discussed.

The frame 312 includes arm portions 320a, 320b which are respectively connected to base portions 322a, 322b at an interconnection 324. The interconnection is provided by a swaged end formed on each of the arm portions and inserted into the end of the respective base portion. A screw element 326 establishes the tight engagement between the respective arm portion and base portion. A tray, identified at 328, joins the upper ends of the arm portions 320a, 320b.

As is shown in more detail in Figure 31, each of the base portions includes an inclined segment 322c and a horizontal segment 322d, with the horizontal segments being joined by a



transverse segment 322e. The inclined horizontal and transverse segments are joined in continuous fashion and formed by a single tubular element which is bent to form the respective sections.

In the bent region between the inclined and horizontal segments 322c and 322d respectively is a hole 323 to which is attached a foot rest of the type illustrated in previous embodiments. One of a pair of supports 322f joins the respective inclined segment with the adjacent horizontal segment. Pivotaly mounted to the support 322f is a back support portion 326 formed of angular segments 326a, 326b which depend from a transverse segment 326c. A hole 326d is formed at the remote end of each of the respective angular segments to locate a tightening screw 328 which is threadably engaged with the respective support 322f. The horizontal segment 322d is also provided with a support post 330 which carries brackets 332 to locate the back support relative to the frame. Each of the brackets 332 includes spaced flanges 332a with a tightening screw 334 threadably engaged with one of the spaced flanges to engage the side wall of a respective angular member. As shown in Figure 34, the support post 330 is height adjustable by way of a rod portion 330a in threaded engagement with a cylindrical portion 330b.

The back 316 includes a body 316a formed from a pair of side walls 316b joined to a transverse wall 316c. A cushion 316d is coupled to the transverse wall 316c by attaching a pair

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of complementary Velcro straps 316e located on the rear and front faces respectively of the cushion 316d in the transverse wall 316c. The seat 314 is positioned relative to the frame 322 by way of a transverse bar 318 which extends between the supports 322f. The seat 314 includes a base 314a having vertical side walls 314b upwardly extending from the lateral edges of a bottom panel 314c, a front portion of which is upwardly inclined in advance of the side walls 314b. A pair of brackets 314d engage the lower face of the transverse bar and are attached to the bottom panel 314c. A cushion 314e is of a shape complementary to the base 314a, and is connected thereto by way of complementary Velcro straps 314f positioned on the respective surfaces.

The tray 328 is formed from an outer peripheral frame member 336, the respective ends of which abut the ends of the arm portions 320a, 320b, and an inner peripheral frame member 338 which is padded to offer protection against user injury. A panel 339 extends between the inner and outer frame members to provide a working surface. The tray has a first lateral end, identified at 340 in Figure 32, which locates an insert 342 adjacent a longitudinal slot 344. The slot receives a tightening screw 346 which is threadably engaged with a hole 342a in the insert 342. The tray is also provided with a second lateral end 348, shown in Figure 33 in which is welded an insert

350. A hole is provided in the lower face of the adjacent arm portion 320a and is identified at 352. Surrounding the hole is a support strap 354 which is threaded with the hole to receive a tightening screw 356 for abutment in an annular groove 358 formed near the remote end of the insert 350. Also formed on the end of the adjacent arm portion 320a is an abutment 360 formed from a bent wire which is welded to the lower face of the arm portion. It is also to be noted that the arm portion 320b is provided with a hole and the appropriate support strap identified at 354a in Figure 32 in order to receive the insert 350 in an alternative configuration as will be described.

The chair 300 is provided with a dampening mechanism 360 which is of the same form as that utilized in a previous embodiment, and will therefore not be discussed in detail further.

In operation, the chair offers a number of advantages for the user, including a back rest 316 which is easily adjustable relative to the seat 314. This is achieved by simply adjusting the height of the support post 330 to cause the back rest 316 to rotate about supports 322f in the desired manner. The back rest also may be easily folded to a horizontal position to reduce the volume needed for shipping, simply by releasing the tightening screw 344 and rotating the back support frame about the supports 322f.

As in the previous embodiments, movement of the seat 314 is dampened by the dampening mechanism. However, it is to be noted that rotational limits of the chair may also be provided by way of a rotation limit device, and a spring may be used to bias the seat to a desired orientation.

The tray also provides an enhanced versatility in that it may be pivotted from the operative position as shown in the drawings to a vertical orientation, depending from arm portion 320a simply by displacing the insert 342 in a forward direction. This is done by releasing tightening screw 346 and displacing the same forward along the slot 344 until the end of the insert 342 is removed from the arm portion 320b. The tray may then be pivotted about the insert 344, by releasing slightly the tightening screw 356. The rotation of the tray beyond the vertical depending orientation is inhibited by the abutment 360.

The tray 328 has the additional feature in that it may be reversed to permit the tray to be pivotted to a vertical depending position from the arm portion 320b. In this case, the tightening screw 356 is released from the hole 352 and placed in the appropriately threaded hole and strap 354a as earlier noted. The tray is first brought forward to withdraw the inserts 342 and 350 from the respective arm portions, then reversed to enable the inserts 342, 350 to be placed in the

opposite arm portions, thereby aligning the annular groove 358 with the repositioned tightening screw 356.

If desired, the seat 314 may be split along a centre line parallel to the central axis of the frame portions, as is shown by dashed lines 352, 354. In this case, a dampening mechanism 360 would be provided for each of the seat portions formed by such a separation. This would enable independent rotation of the seat segments which is considered particularly important in the case of stroke patients, as well as to geriatric patients, by providing exercise to the upper legs about the hips.

Also contemplated is the use of a number of accessories in the panel of the tray as shown in Figure 34, namely a cosmetic kit with a digital clock or vanity mirror, or an intercom, not shown.

Although not shown, the support post 330 may be height adjustable to a number of preset heights, thereby allowing the back support portion 326 to be oriented in a corresponding number of preset orientations relative to the chair.

An alternative chair is illustrated at 410 in Figures 36 to 42. The chair has a frame assembly 412 including a rear

section 414 to support a seat 416, a back 418 and a user support assembly 419, which is also coupled to the seat to allow coordinated movement therebetween as will be described. The frame assembly 412 has a pair of right and left hand front sections 420a, 420b which are removably attached to the right and left hand sides respectively of the rear section 414 by a pair of attachment assemblies 422a, 422b. The frame assembly 412 also supports the wheel assembly 423 and a foot rest assembly 424, as will be further described.

Referring in more detail to Figure 42, the rear section 414 has right hand and left hand segments 426a, 426b respectively which are formed from a continuous tubular member. Each of the right hand and left hand segments has an upper portion 428 which is inclined slightly downwardly toward a lower horizontal portion 430, while a central portion 432 joins their respective front ends and is inclined slightly rearwardly from the vertical. A back support portion 434 depends from the rear end of the upper portion 428 and has a forwardly cantilevered seat support portion 436. An upper transverse member 438 joins the front ends of the seat support portions 436 while a lower transverse member joins the rear ends of the lower portions 430.

Each of the right and left hand front sections 420a, 420b includes upper and lower portions 444, 446 which are

parallel to the respective inclined and horizontal portions of the rear section, and are joined at their front and rear ends respectively by front and rear portions 448, 450 which are oriented parallel relative to the central portion 432.

The features of the attachment assemblies 422a, 422b are shown in more detail in Figure 41 and include a pair of pins 452 extending from the rear face of the rear portions 450 to be inserted into corresponding holes 432a formed in the front face of the central portions 432. A ball clamp 454 encompasses the laterally inner and outer peripheries of the central and rear portions and is formed by a pair of clamp segments 454a, 454b. Each of the segments has an inner surface 454c complementary with the outer surface of the respective frame portion, while holes are provided at 454d to receive a tightening screw 454e.

As is shown in Figure 36, a rear caster wheel 456 and a middle fixed wheel 458 are provided on the lower portion 430, while a front caster wheel 460 is positioned at the front of the lower portion 446. The wheel assembly 423 operates in the same manner as in previous embodiments and will thus not be described further.

Each of the lower portions 430 also supports a pair of foot rest assemblies 423, which include a foot rest member 423a

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pivotally mounted on a shaft member 423b, the ends of which are bent so as to be attached to the corresponding inner side face of the lower portion 430.

A particular feature of the chair 410 is the user support assembly 419 which is illustrated in more detail in Figure 39. A support member 462 is pivotally mounted to the upper ball clamp element 454a and to a belt 464, by way of pivot mechanisms 466 and 468. The belt 464 is formed from a pair of rigid curved panels 470 with a foam liner 472 attached to each of their inner faces, and a stretchable pad 474 extending between their rear remote ends. A pair of straps 476a, 476b extend from the front remote ends of the curved panels 470, with the strap 476b terminating at a buckle 478.

It can thus be seen that the user support assembly 419 is adaptable to a number of waist sizes. In addition, by virtue of its attachment to the ball clamp 454, the user support assembly 419 is height adjustable for a wide range of user waist heights.

Reference is made to Figure 40 illustrating the pivot mechanism 466 which is attached to the respective curved panel 470 by way of a hole 470a and a corresponding screw 470b extending through the hole to engage a bronze bearing shoulder



470c. A bearing surface 470d extends outwardly from the bearing shoulder 470c on which is placed a nylon washer 470e, pivot elements 470f, 470g, a washer 470h and a threaded cap 470i, the threaded cap being threaded to the remote end of the surface 470d. The pivot element 470f is fixed to the upper end of the support member 462 while the pivot element 470g is attached to a lever as will be discussed.

The pivot mechanism 468 is equivalent in structure to the pivot mechanism 466 with the exception that the shoulder 470c is mounted to the inside ball clamp member 454a. In addition, a pivot element corresponding to 470f is not used in pivot mechanism 468. With reference to Figure 42, there is also provided a block 472 affixed to the inner surface of the rear frame portion 450 for limiting forward movement of the support member 462.

Joined to the pivot element 470g on each side of the belt 464 is one end of a lever member 474, while the other end is pivotally mounted to the front end of the seat 414 to coordinate movement of the support assembly with the seat as will be described.

In use, the user enters the chair from the front between the frame sections. The support assembly 419 is then

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strapped around the user's waist, with the appropriate adjustments made for height and width by way of the upper ball clamps 454 and the buckle 478 accordingly. The user may then operate the chair in a standing position, wherein the lever member 474 ensures that the seat 414 is in a storage position so as not to interfere with the movement of the user. The user is then free to manoeuvre the chair in the desired direction so as to exercise his legs, while grasping the upper frame portions for support.

Should the user inadvertently fall forward, the blocks 472 prevent the rotation of the support member 462, thereby preventing his falling forward in the chair. Alternatively, should the user fall backward, the levers 474 are displaced downwardly to cause corresponding rotation of the seat 414 to the operative position. At the same time, the support member 462 ensures the safe alignment of the users buttocks with the seat 414.

The removable nature of left and right hand front sections 420a, 420b not only reduces the space requirements for shipping, but also allows the chair to be used in one of two configurations. In place, the right and left front sections 420a, 420b provide a support rail extending in front of the chair 410, by way of upper portions 444. Being inclined, the

support rail allows the user to support himself in a comfortable stance at a range of locations depending on his height, arm length and the like, while at the same time provides additional support for the user when entering the chair 410.

With the left and right front sections 420a, 420b removed, the user is provided with a lightweight and compact wheel chair.

A further feature of the chair 410 is the inherent flexibility afforded by the rectangular spiral shape of the frame sections 426a, 426b, which serves to absorb vibrations in the rolling surface, while reducing the force of impact should the user fall.

With reference now to Figures 43, 44 and 45, an alternative chair is illustrated at 510 having a frame 512 which supports a seat 514, a back 516, foot rests 518 and a wheel assembly 520, all of which will be described.

The frame 512 is formed from left and right hand angular members 522, each of which has a vertical portion 522a and a horizontal portion 522b, the latter carrying a fixed axle wheel 520a at its rear end, and a caster wheel 520b at its front end. An inverted angular member 524 is attached to the

laterally inner face of the respective angular member 522 and includes a vertical portion 524a and a horizontal portion 524b extending rearwardly from the vertical portion 524a. The rear end of each of the horizontal portions 524b are joined to a transverse member extending behind and to which is attached the back 516.

A particular feature of the chair 510 is the seat 514 which is provided for use as a replacement to or in conjunction with a toilet. Provision is made in a body 514a of a passage 514b with panels 514c and 514d hinged near the lateral edges of the body, with the remote end of each panel having a formation 514e thereon. The formation 514e is complementary to a half section of the passage so as to close the passage when the panels are in aligned position with the body 514e. A pair of latches 514f are slidably mounted on the panel 514e to engage eyelets 514g on the hinged panel 514d, so as to maintain the panels in the aligned position.

The foot rests 518 include a sleeve portion 518a is slidably mounted near the front end of each of the horizontal portions 522b and has an outwardly extending foot plate 518b, shown in the stored position in the drawings. Extending in the opposite direction to the foot plates 518b are wheel lifts 518c which serve to disable the caster wheels 520b when the chair is

stationary. This is provided to minimize user injury when approaching or leaving the chair.

While the chair is lightweight and rigid to offer suitable support to the user, the upwardly tapered frame, as shown in Figure 44, allows the chair to be stacked on other chairs during storage. The open-ended frame also enables the passage to be aligned with a toilet bowl. Alternatively, provision may be made on the lower face of the base 514a to receive a catch basin, by way of tracks or other appropriate fasteners.

Moreover, the passage may be opened while the patient is sitting on the chair. In this manner, suitable support may be given to the patient while in transport to and from the toilet, while at the same time the passage may easily be activated without the need of removing the patient from the chair. In addition, the chair is applicable as a shower chair, provided of course the materials in making the chair components are selected accordingly.

Several alternatives exist for the foot rest 518, including a foot rest which is formed from a wire grid, or other suitable structure to provide a friction covering, while at the same time the wheel lift 518c may be covered with a rubber material in order to enhance the frictional engagement with the ground.

Also contemplated is the use of a buzzer, not shown, placed on one of the horizontal portions to enable the user to seek help. While a number of features have been disclosed for each of the above embodiments, it is to be understood that the features may be appropriate for other or all of the embodiments.

CLAIMS

1) A mobile support device for a handicapped person and rollable on a reaction surface, the mobile support device comprising:

first and second substantially parallel planar frame sections oriented in spaced relationship to define a region therebetween, the lower portion of said frame sections defining a base;

a back support portion spanning the region and coupled with the first and second frame portions;

a seat spanning the region with at least a front portion thereof pivotable relative to said first and second frame portions; and

a wheel assembly mounted on said base so as to engage the reaction surface.

2) A mobile support device further comprising a releasable restraint means spanning the region in front of the seat portion and coupled to the first and second frame portions.

3) A mobile support device wherein the whole of said seat is pivotal relative to said first and second frame portions.

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- 4) A mobile support device as defined in claim 3 wherein the seat is pivotal between a first and a second position in which said seat is forwardly downwardly inclined.
- 5) A mobile support device as defined in claim 4 wherein the first position is a rearwardly downwardly inclined orientation.
- 6) A mobile support device as defined in claim 1 further comprising adjustment means to adjust the height of the seat relative to the frame.
- 7) A mobile support device as defined in claim 6 wherein said seat includes a seat frame, movable relative to said frame, said adjustment means includes guide means engaged with said seat frame, to guide said frame along a predetermined path relative to said frame.
- 8) A mobile support device as defined in claim 7 wherein said seat frame includes a pivot element defining an axis of rotation of said seat and movable relative to said guide means.
- 9) A mobile support device as defined in claim 8 wherein said adjustment means includes a rack and pinion arrangement to displace said pivot element relative to said guide means.
- 10) A mobile support device as defined in claim 9 wherein said rack and pinion arrangement includes a rack element fixed



to said pivot element, and a pinion element rotatably coupled with said guide means for displacing said rack element relative thereto.

11) A mobile support device as defined in claim 1 wherein the upper region of first and second frame portions define arm elements on each side of said region.

12) A mobile support device as defined in claim 11 wherein one of said arm elements is separable from the respective frame portion.

13) A mobile support device as defined in claim 11 wherein one of said arm elements is pivotal relative to the respective frame portion.

14) A mobile support device as defined in claim 11 wherein said restraint means includes a tray element releasably joined to said arm elements.

15) A mobile support device as defined in claim 14 wherein said tray is contoured to define a hand grip.

16) A mobile support device as defined in claim 14 wherein said tray extends along one of said arm elements to define an arm rest.

17) A mobile support device as defined in claim 1 wherein said wheel assembly includes a pair of front wheels and a pair of rear wheels, said front and rear wheels being mounted near the respective sides of said base such that the rotation axis of each of said wheels is rotatable relative to said base, and an additional pair of central wheels each of which being mounted near said respective sides and interposed of the associated front and rear wheels, each of said central wheels mounted on said base such that the rotation axis thereof is fixed substantially perpendicular to said frame sections.

18) A mobile support device as defined in claim 17, further comprising braking means for providing releasable resistance to the rotation of said wheels.

19) A mobile support device as defined in claim 18 wherein said braking means includes a mechanism having first rigid link pivotally mounted to said base, said first element pivotally coupled to a second rigid link which extends along the base and terminates at a pivotal connection with a third link, said third link pivotally coupled to said base and having an end joined to a brake pad which is located adjacent the reaction surface of said third wheel.

20) A mobile support device as defined in claim 19 wherein one of a pair of said mechanisms is provided at each of said third wheels, said first links being rotatably coupled on a common pivot axis.

21) A mobile support device as defined in claim 20 wherein said first links are fixed to a common pivot rod along said pivot axis.

22) A mobile support device as defined in claim 1 wherein each of the first and second frame sections has upper and lower frame members in spaced and substantially parallel and horizontal relationship, and a central frame member joining one end of the upper frame member with the opposite end of the lower frame member.

23) A mobile support device as defined in claim 22 wherein the central frame member is formed from first and second frame portions, the first frame portion being joined to the rear end of the upper frame member and the second frame portion being joined to the front end of the lower frame member, the central frame portions being interconnectable at their free ends in a telescoping manner.

24) A mobile support device as defined in claim 22, further comprising outrigging means releasably mounted to said lower frame members to extend outwardly therefrom and engage the reaction surface so as to improve the stability of the device.

25) A mobile support device as defined in claim 24 wherein the outrigging means is releasable from a retracted position to an outwardly extended position.

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26) A mobile support device as defined in claim 25, further comprising trigger means to release the outrigging means from the retracted position to the extended position.

27) A mobile support device as defined in claim 26 wherein the trigger means is responsive to a rotation of the device about a predetermined horizontal axis.

28) A mobile support device as defined in claim 27 wherein the outrigging means is pivotally mounted to the lower frame members and further comprises a rod slidably engaged with a first housing and extends therefrom upon release of the outrigging means.

29) A mobile support device as defined in claim 28 wherein the first housing is biased to the extended position.

30) A mobile support device as defined in claim 29 wherein the trigger means includes a first latch releasable by a latch member oriented in close proximity with the reaction surface, so as to engage the reaction surface upon rotation of the device about the predetermined horizontal axis.

31) A mobile support device as defined in claim 30 wherein the trigger means includes a second latch means to release the rod upon release of the outrigging means.

32) A mobile support device as defined in claim 31 wherein the first latch means is mounted on a second housing, while the second latch means is mounted on the first housing.

33) A mobile support device as defined in claim 32 wherein the first housing is pivotally mounted with respect to the second housing, the second housing defining an abutment to engage the second latch means upon arrival of the first housing at the extended position so as to release the rod.

34) A mobile support device as defined in claim 1 wherein said front portion is tiltable about a rear portion.

35) A mobile support device as defined in claim 34 wherein said rear portion is tiltable relative to said first and second frame portions.

36) A mobile support device as defined in claim 1 further comprising a foot support means extending forwardly of and respectively pivotally coupled with one of said first and second frame sections.

37) A mobile support device as defined in claim 36 wherein said foot rest has an extendable member and includes an adjustment mechanism to adjust the length of said extensible member.

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38) . A mobile support device having an undercarriage comprising six wheels arranged in three sets of two wheels each mounted transversely with respect to said undercarriage, the foremost and rearmost sets being of the caster-type and the other set having fixed rotation axis.

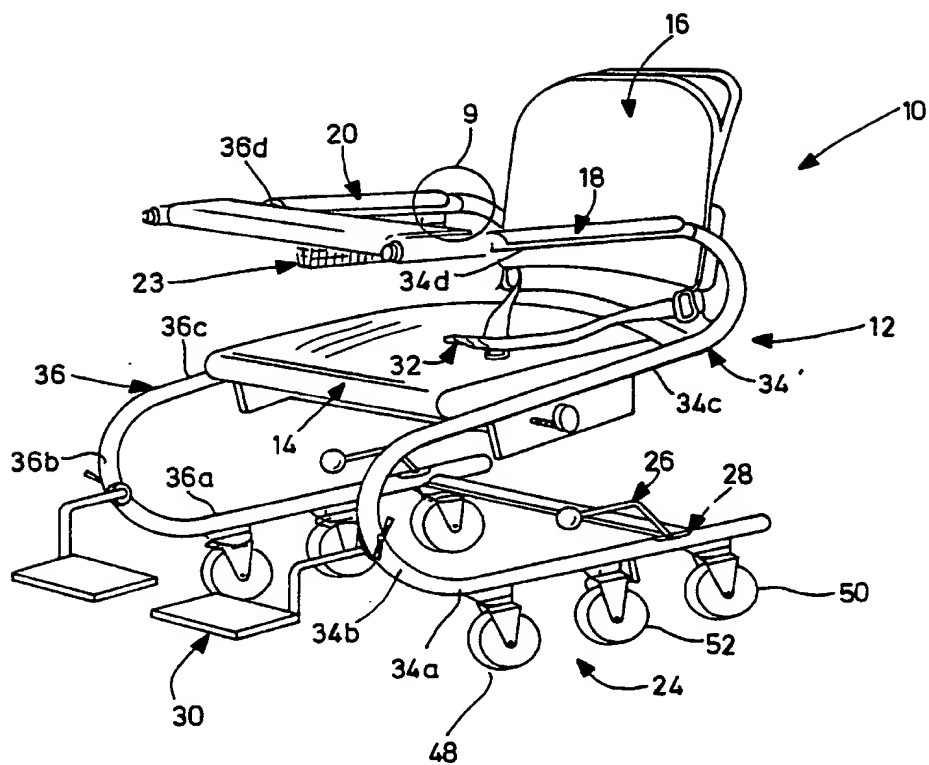


FIG. 1

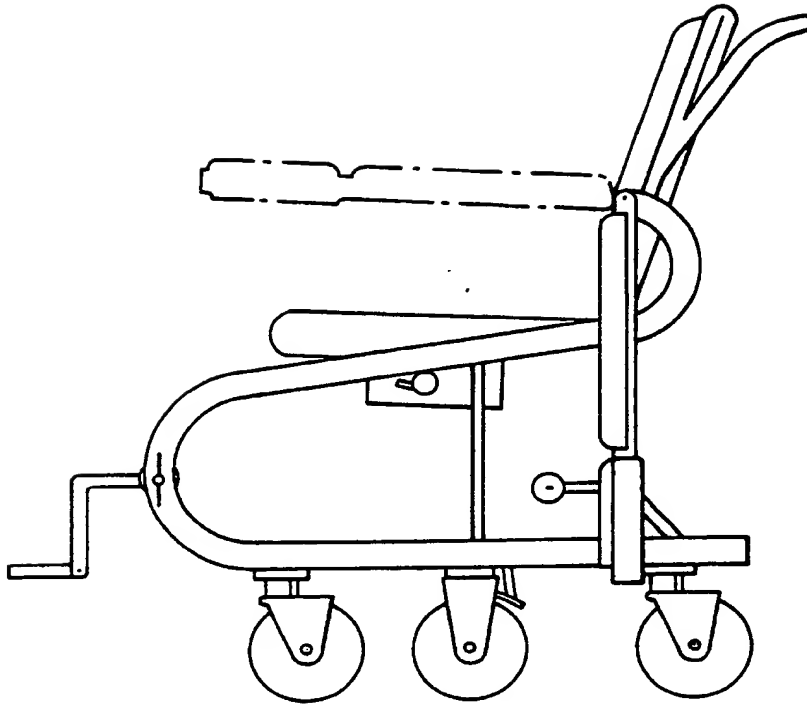


FIG. 2

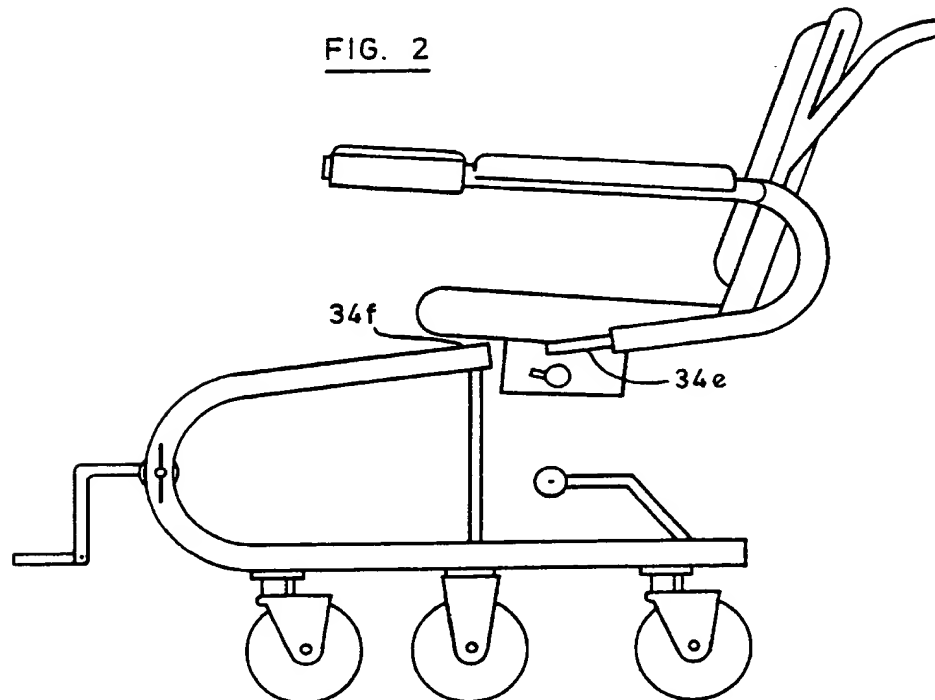


FIG. 3

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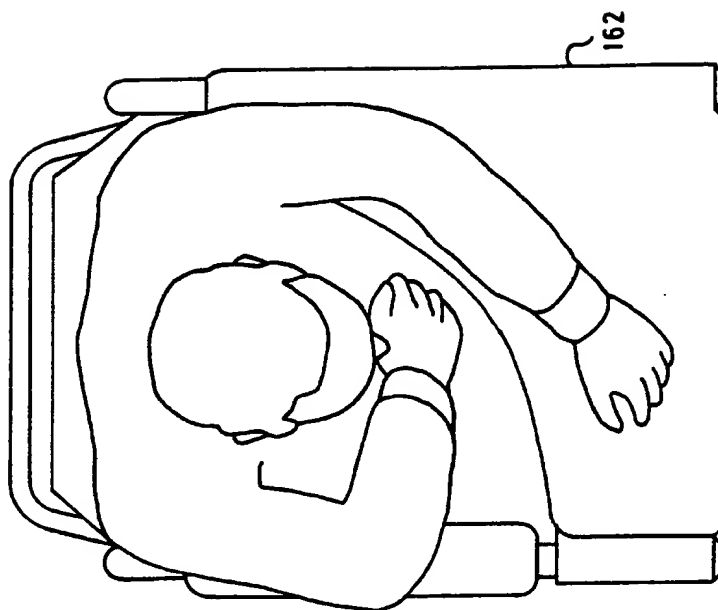


FIG. 5

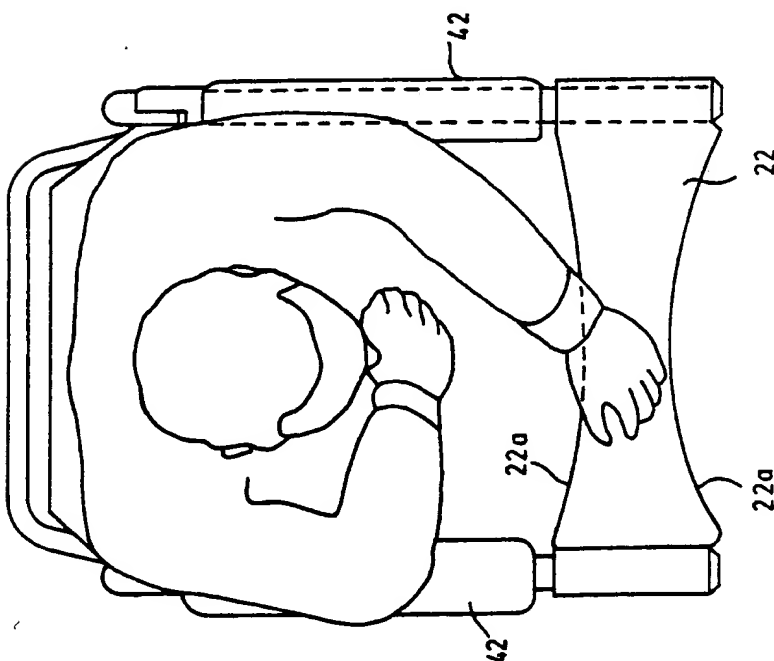


FIG. 4

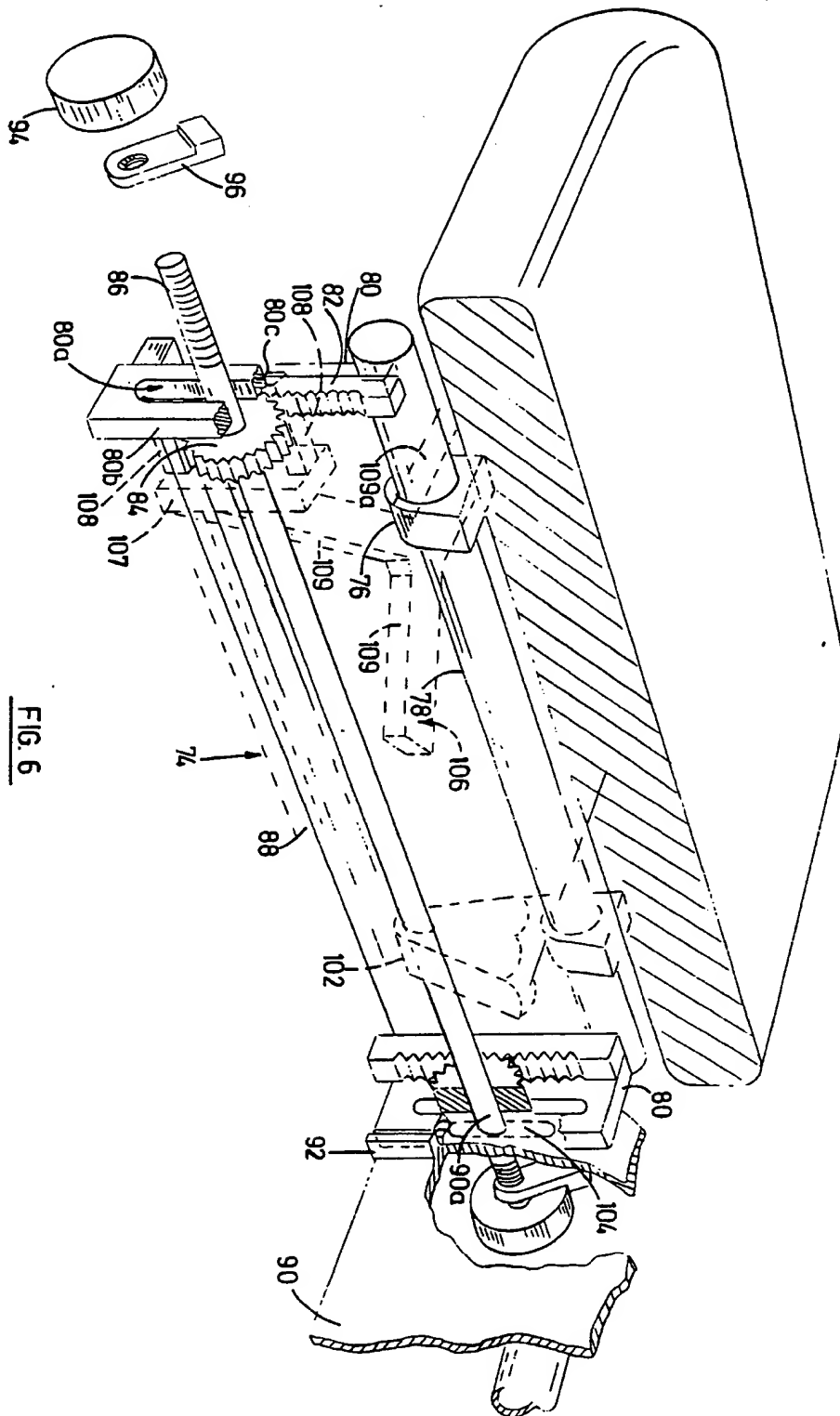


FIG. 6

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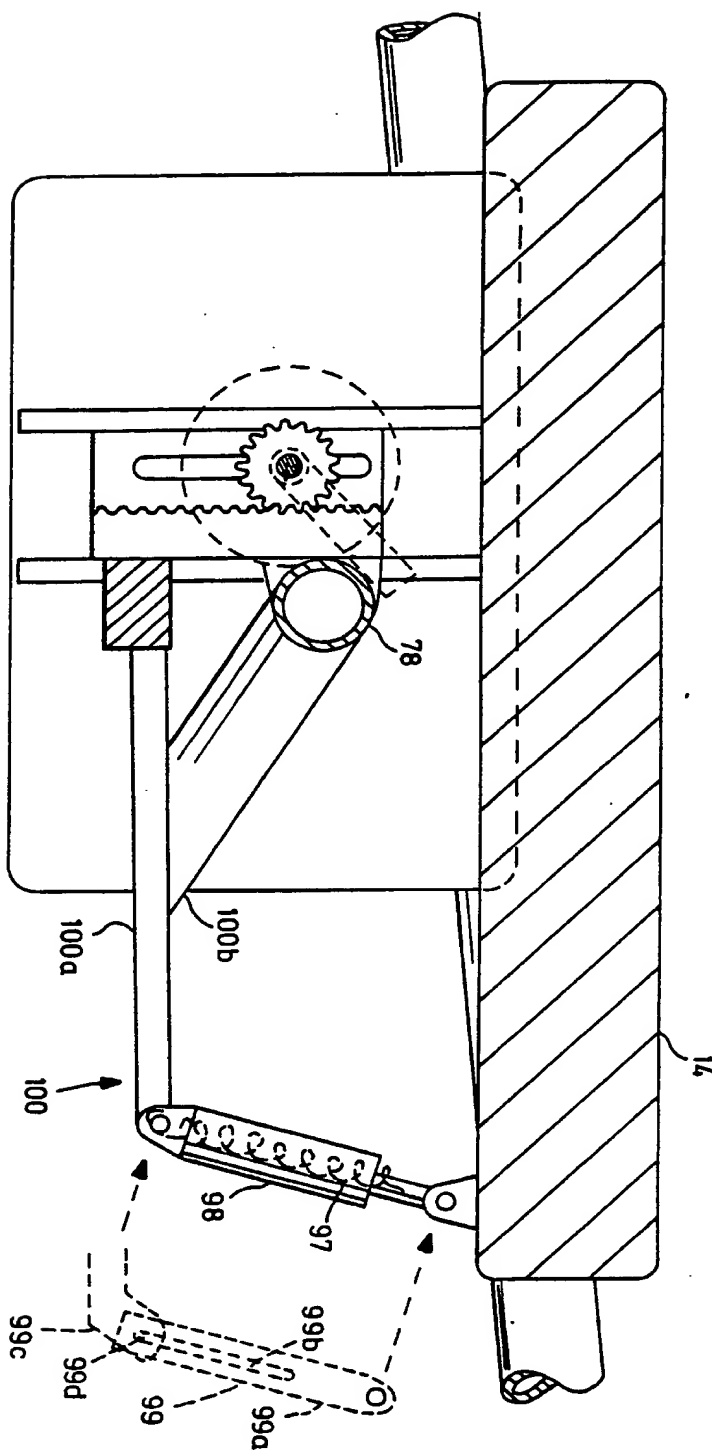


FIG. 7

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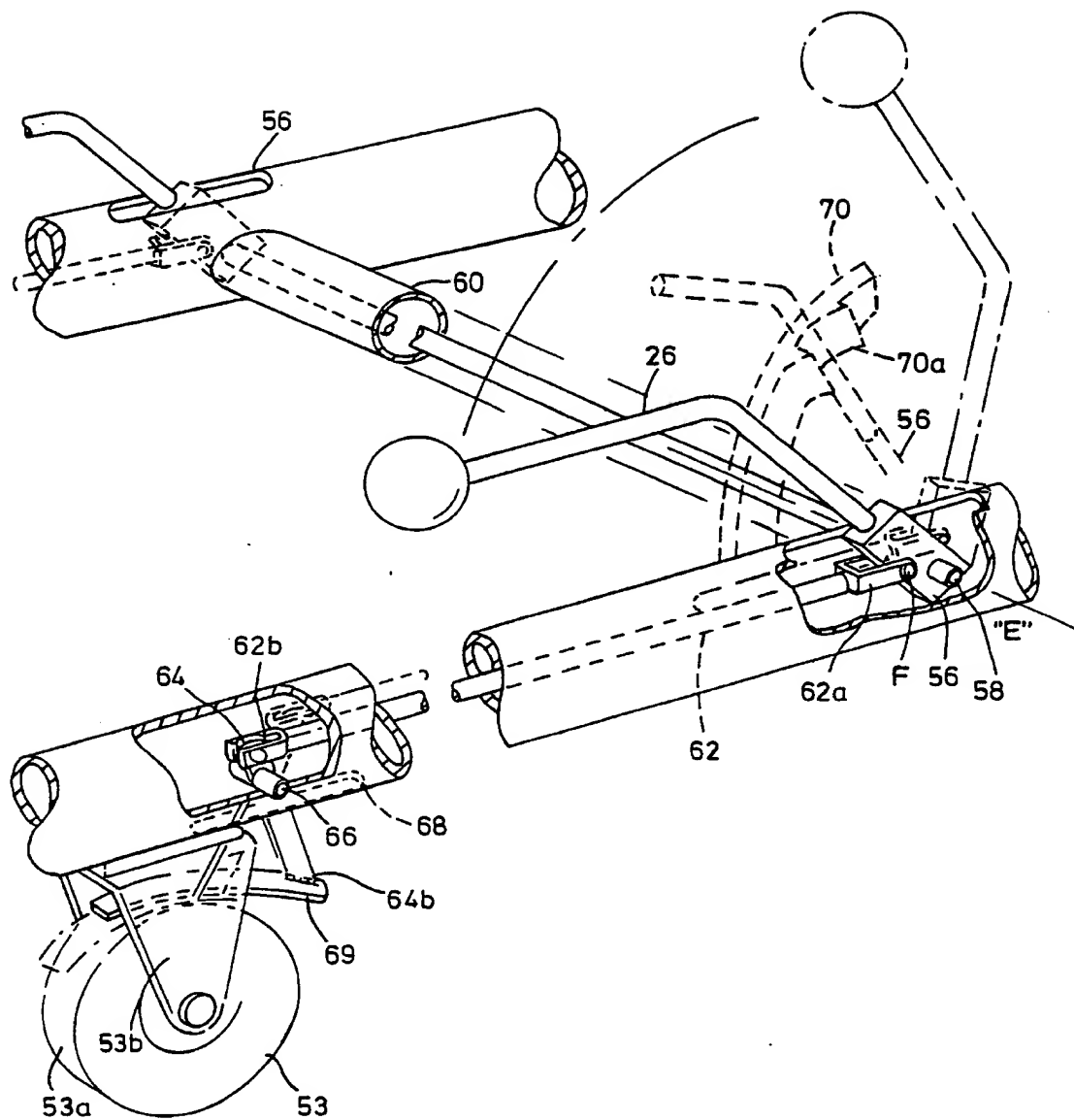


FIG. 8

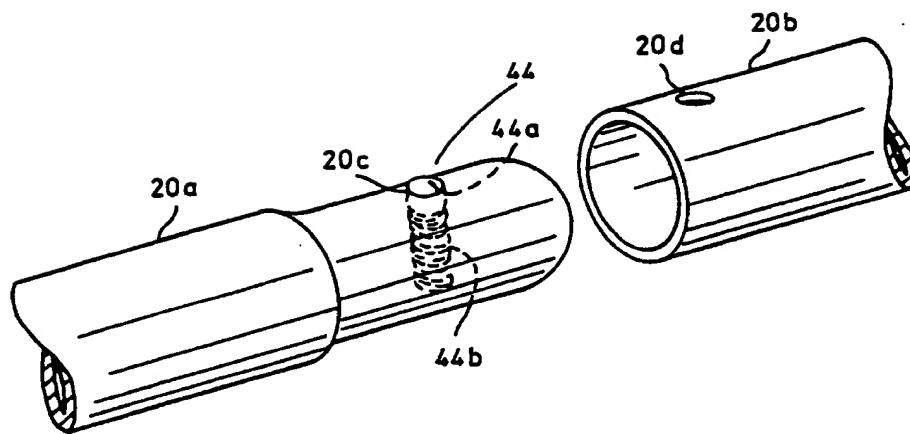


FIG. 9

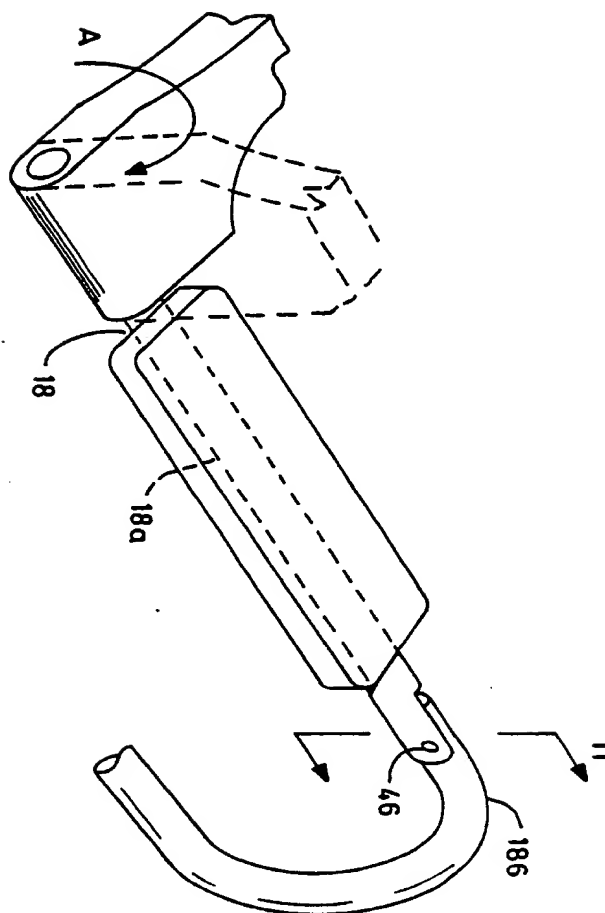


FIG. 10

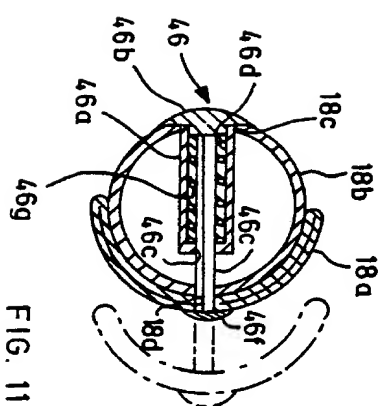


FIG. 11

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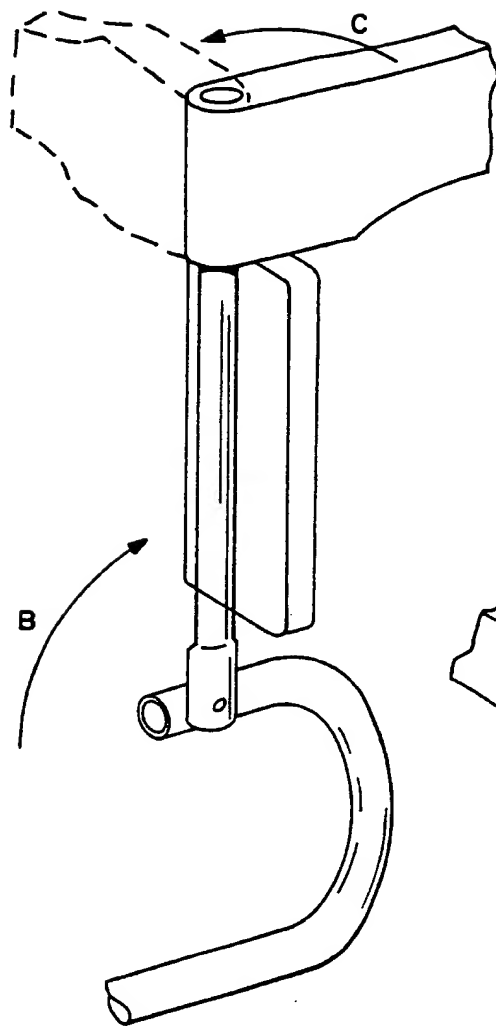


FIG. 12

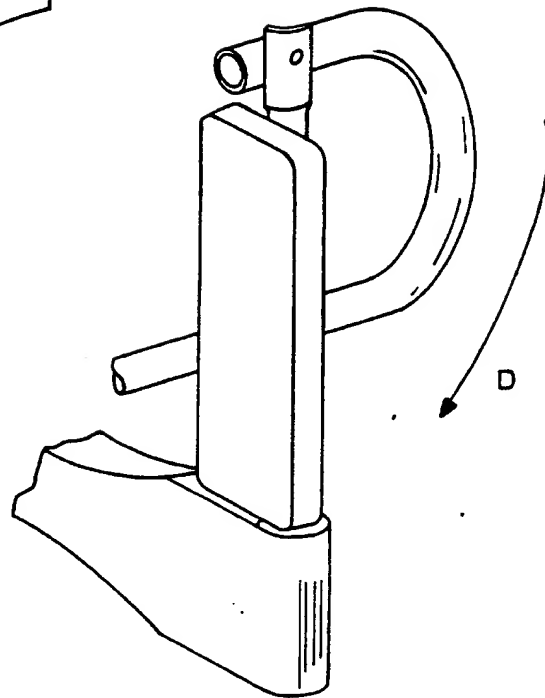


FIG. 13

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10/32

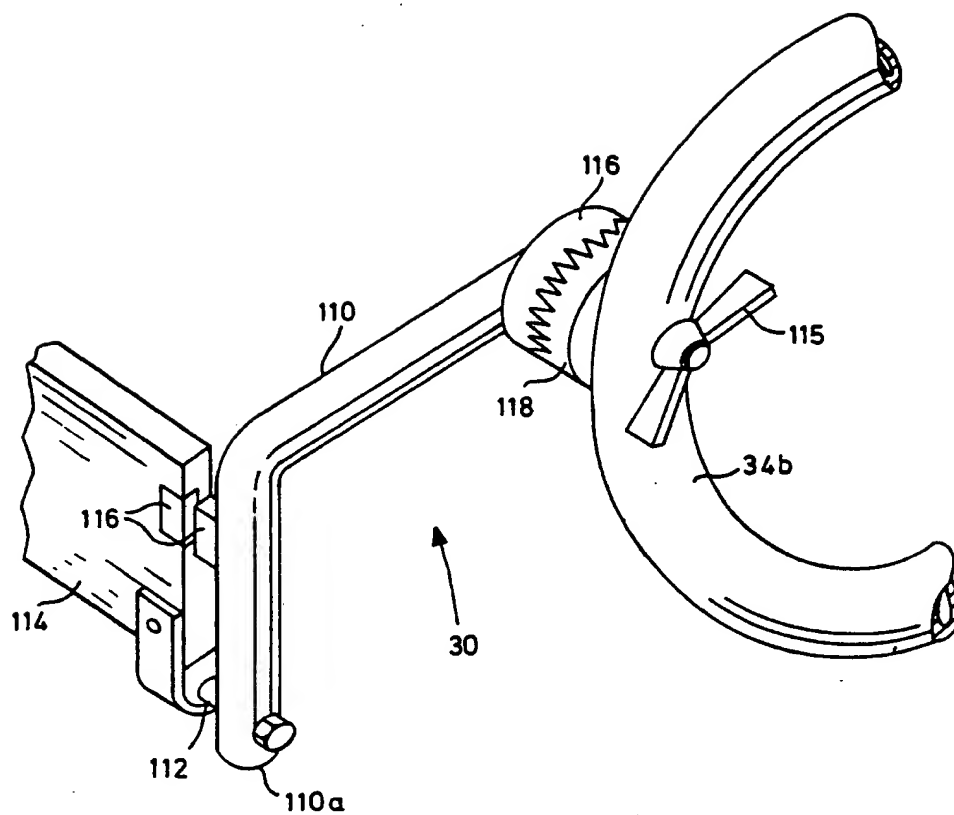


FIG. 14

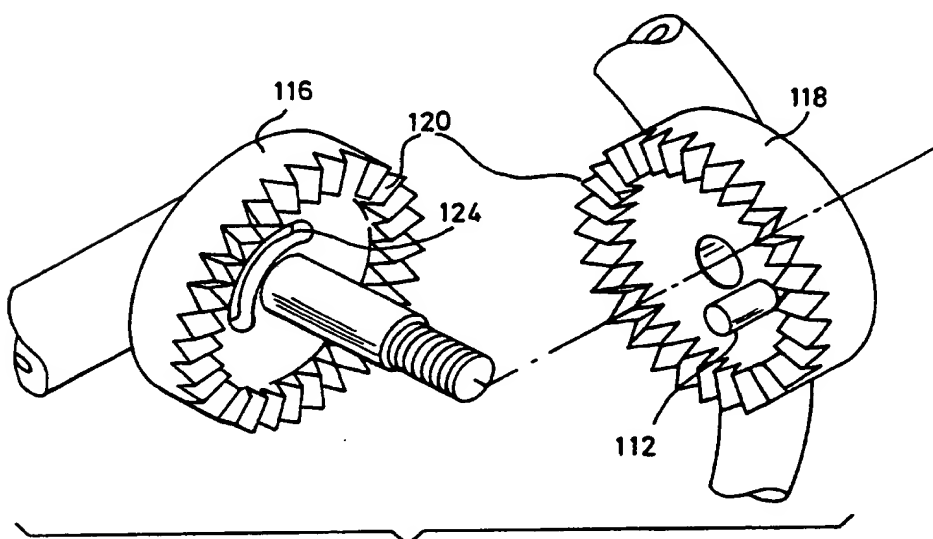


FIG. 15

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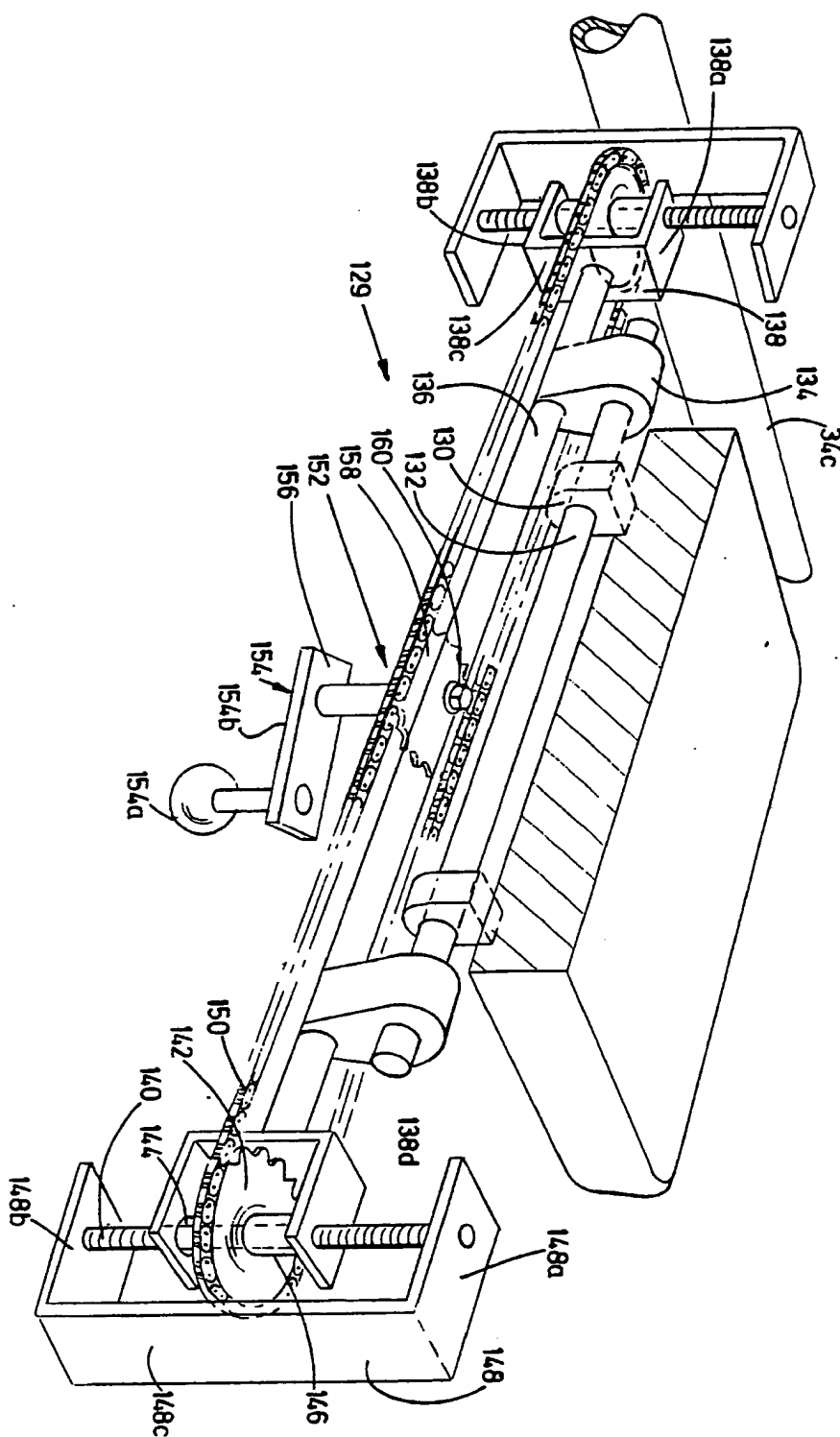
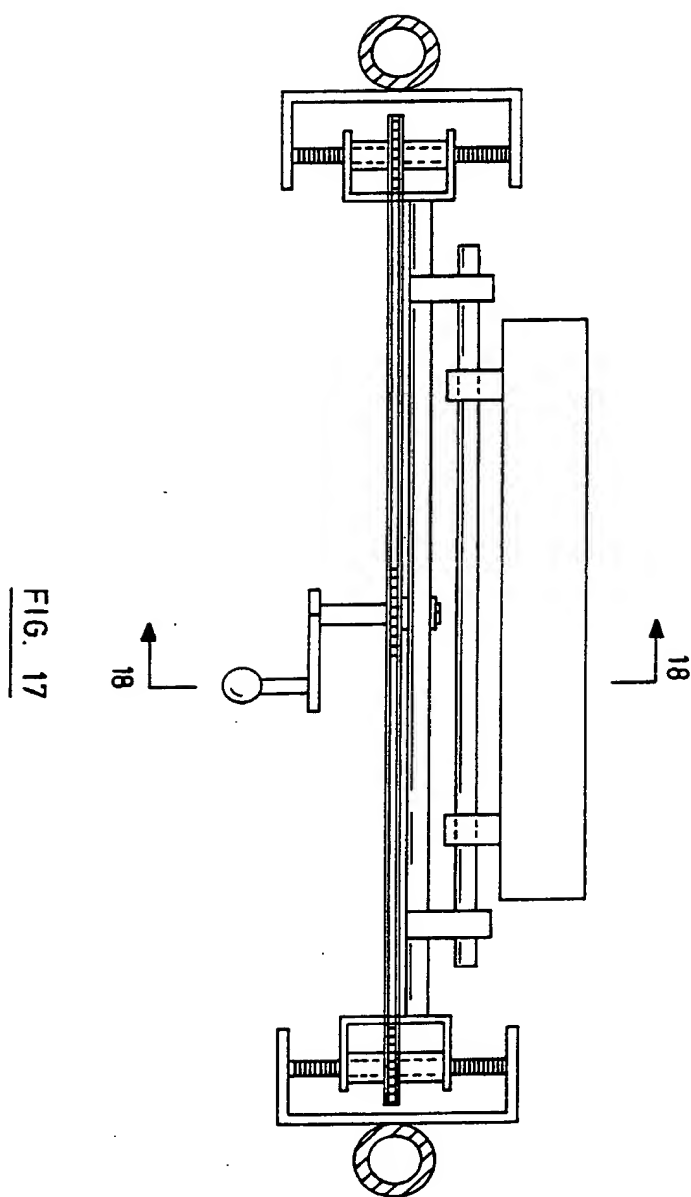


FIG. 16

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FIG. 18

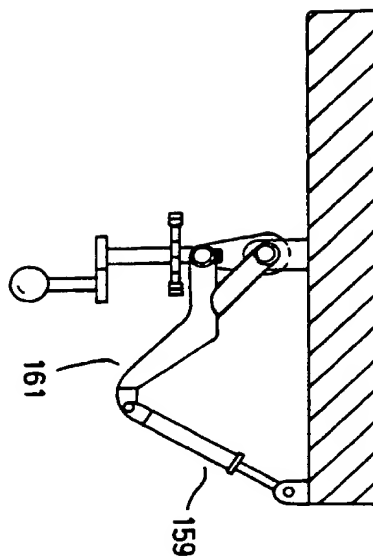
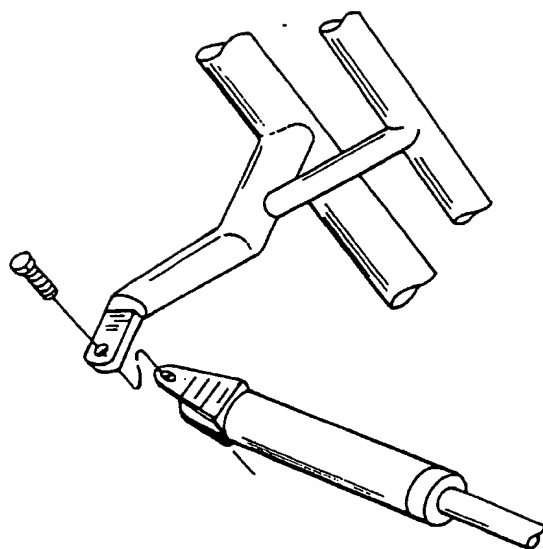


FIG. 19



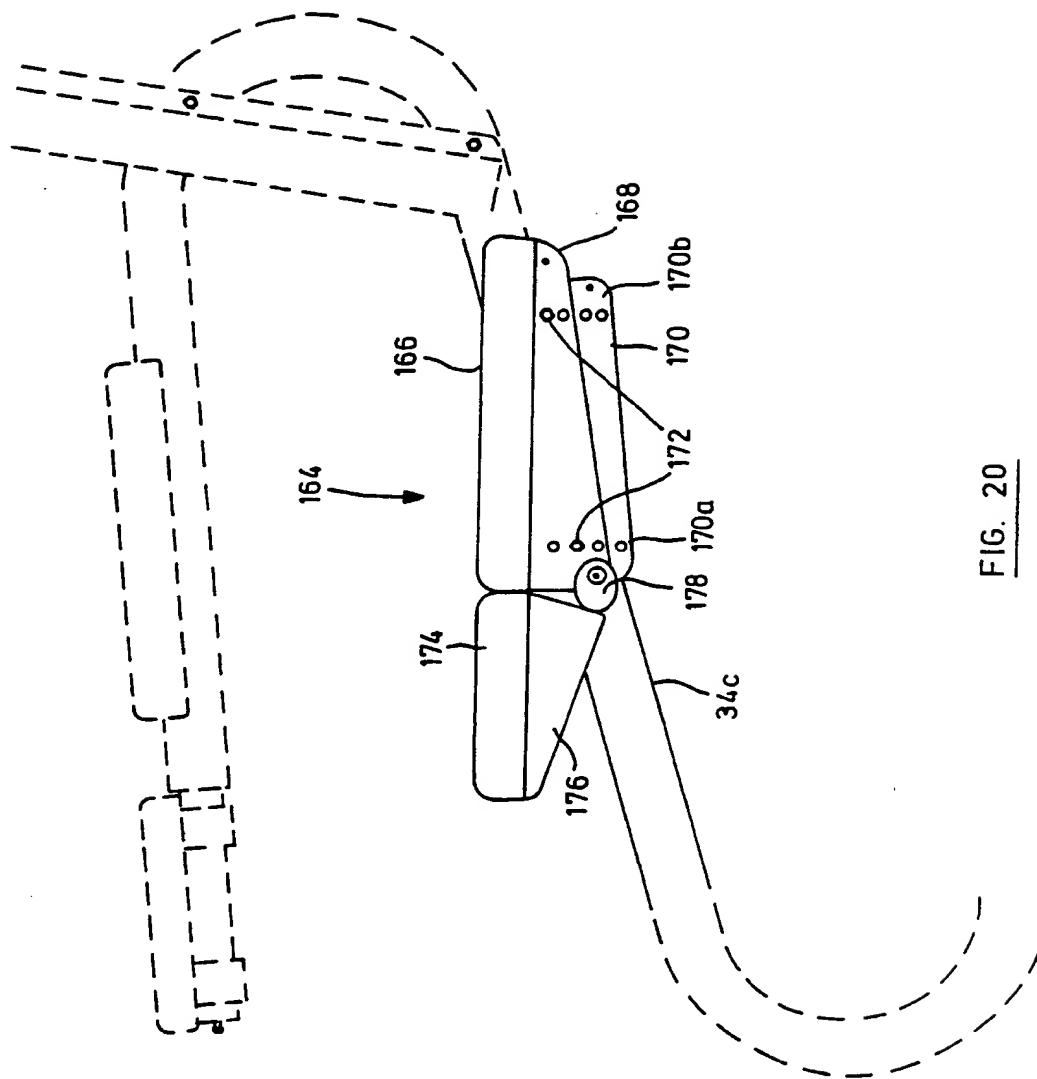
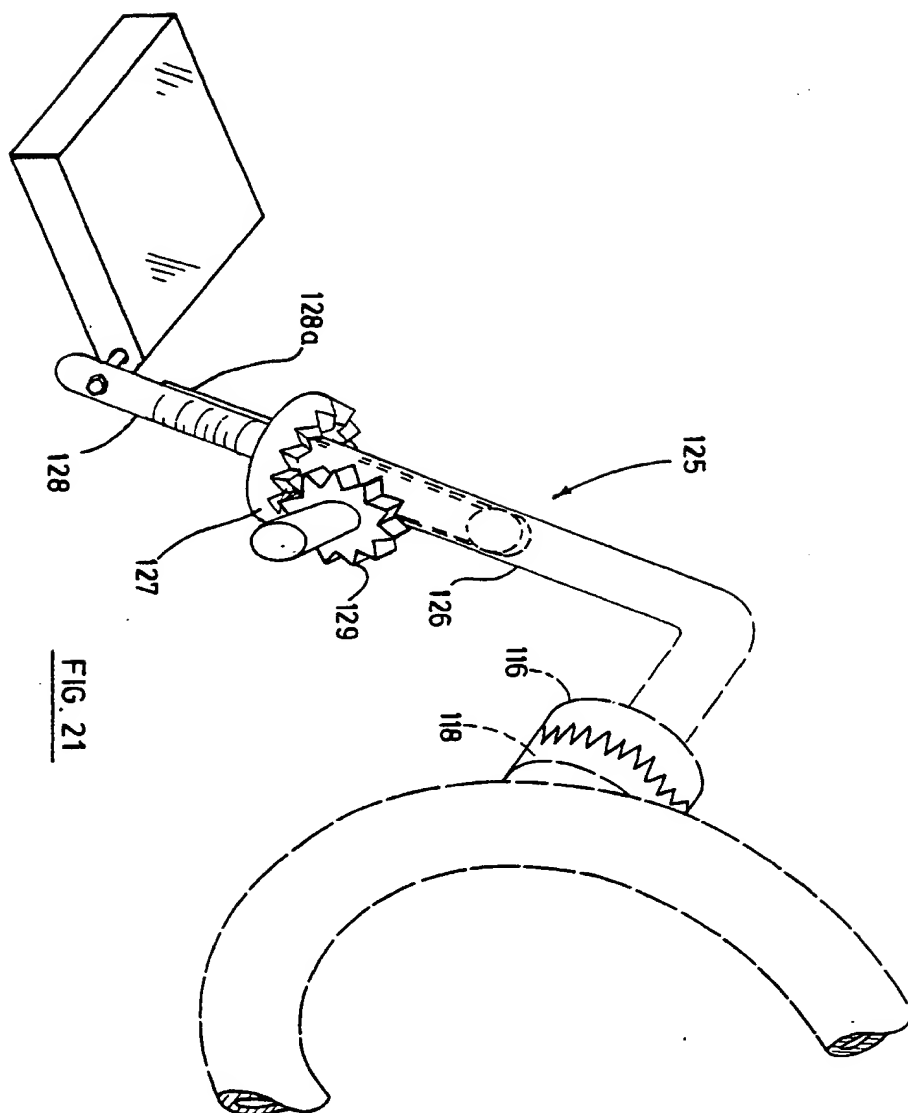


FIG. 20



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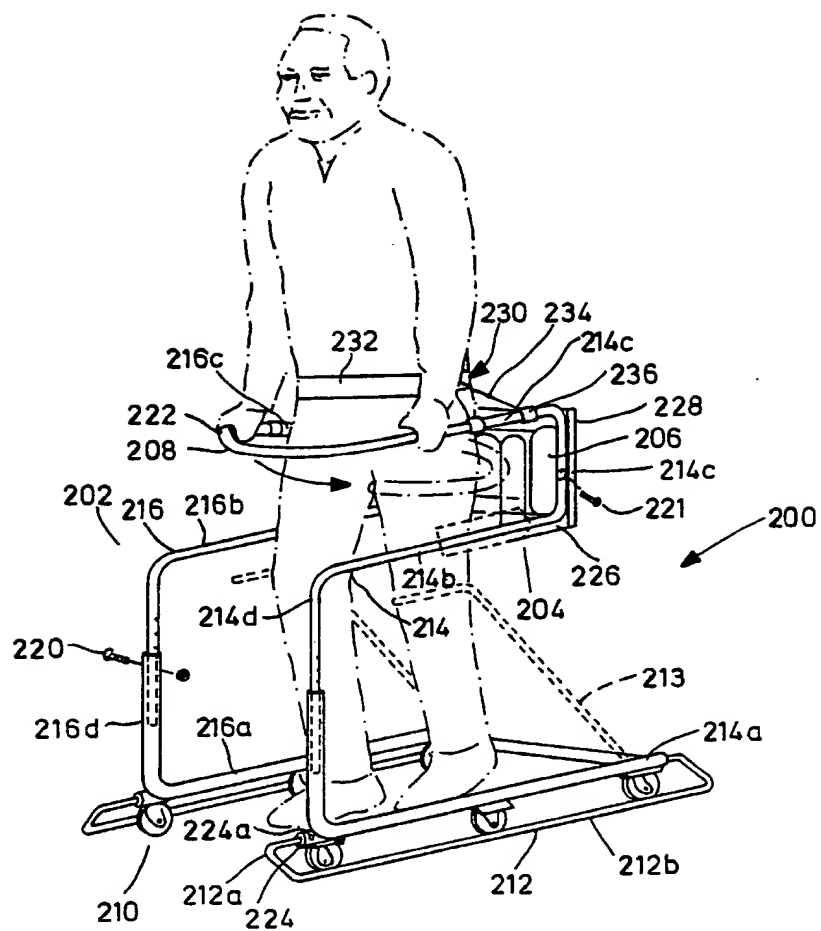


FIG. 22

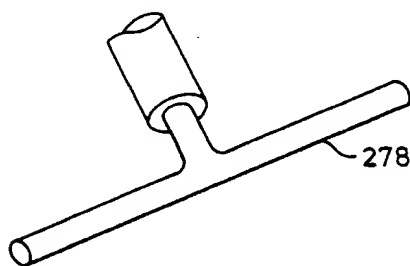


FIG. 26

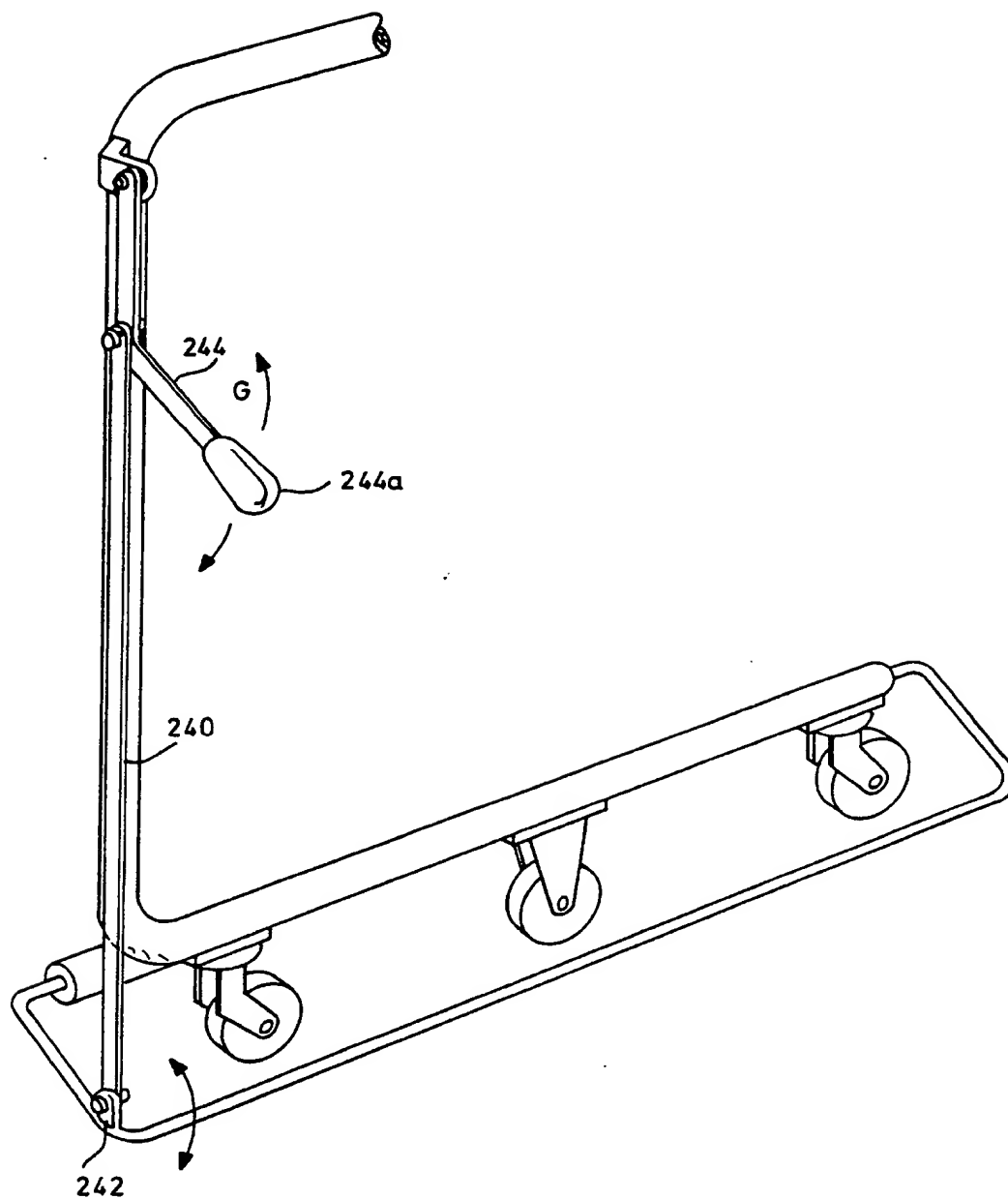


FIG. 23

**SUBSTITUTE SHEET**

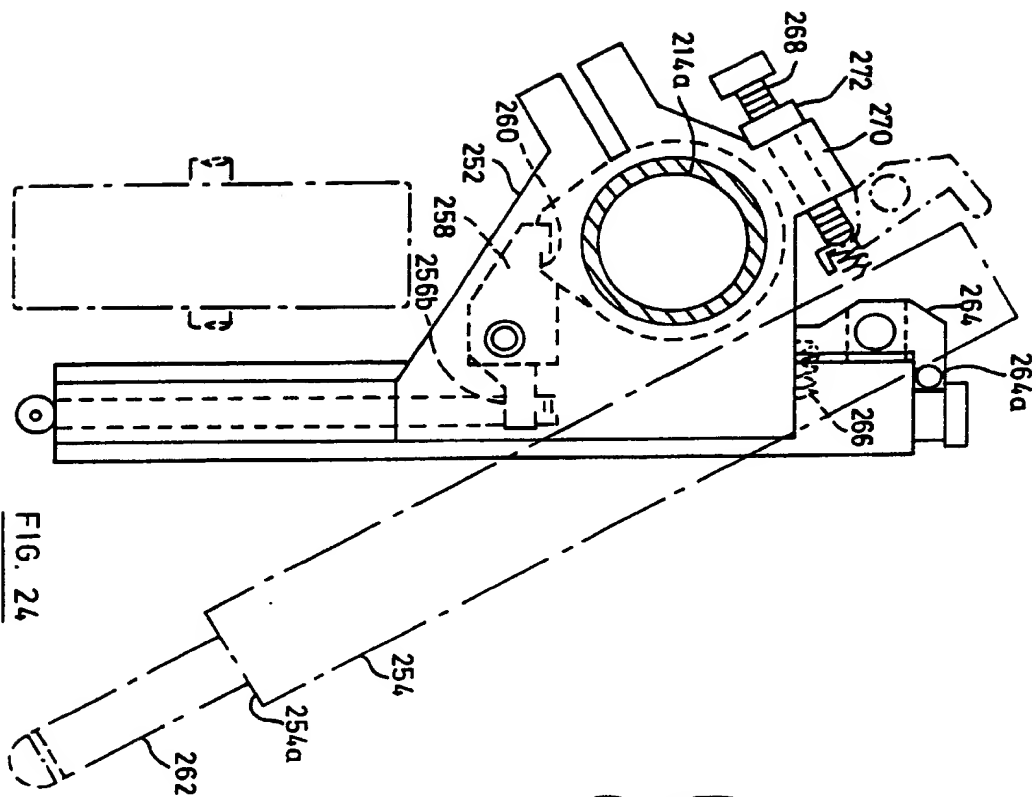


FIG. 24

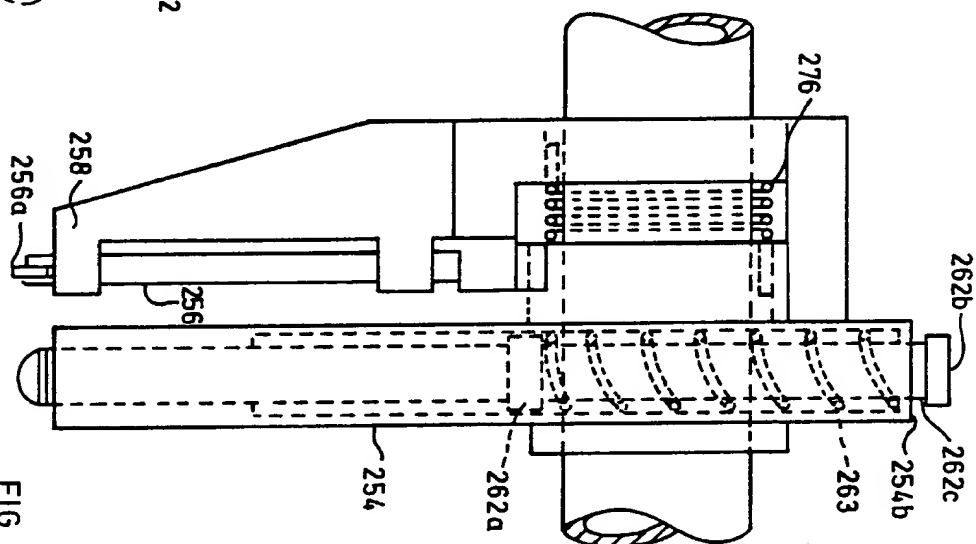


FIG. 25



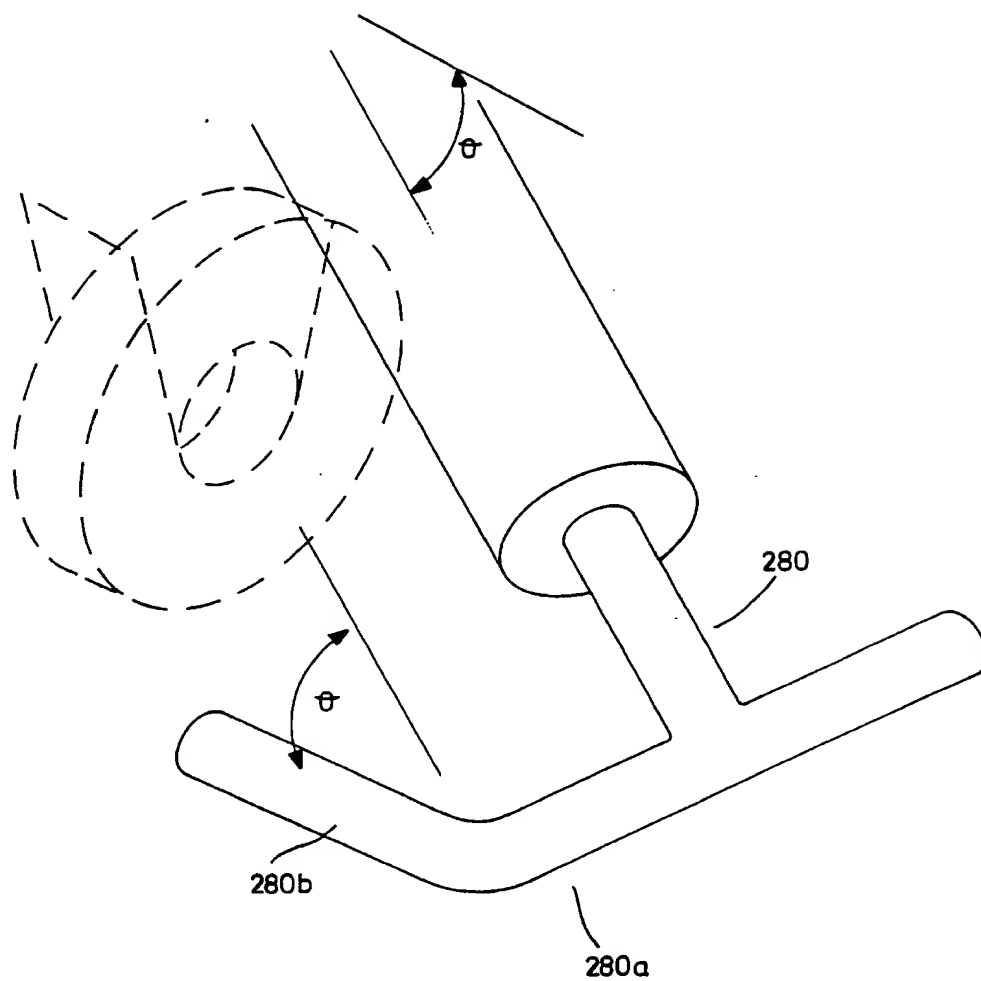


FIG. 27

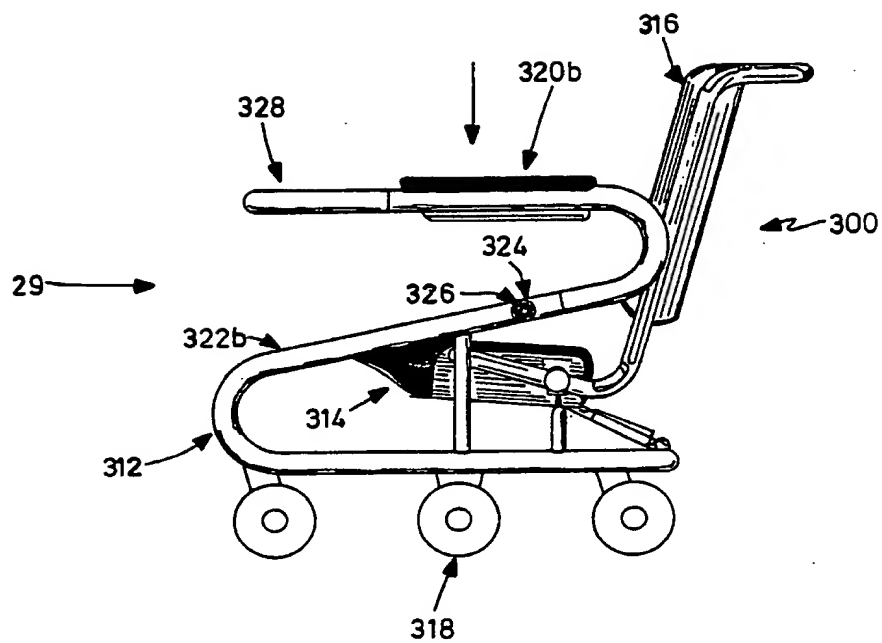


FIG. 28

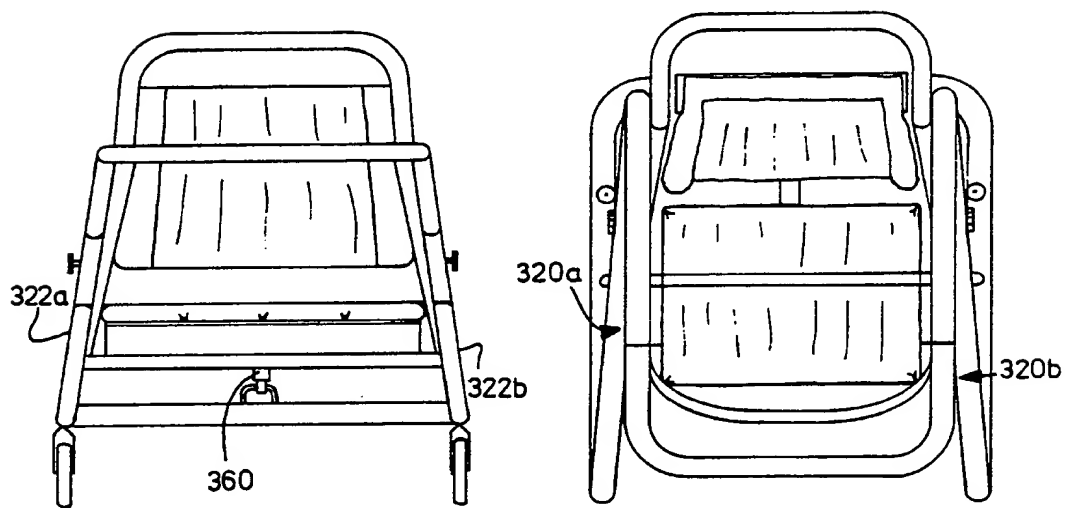


FIG. 29

FIG. 30

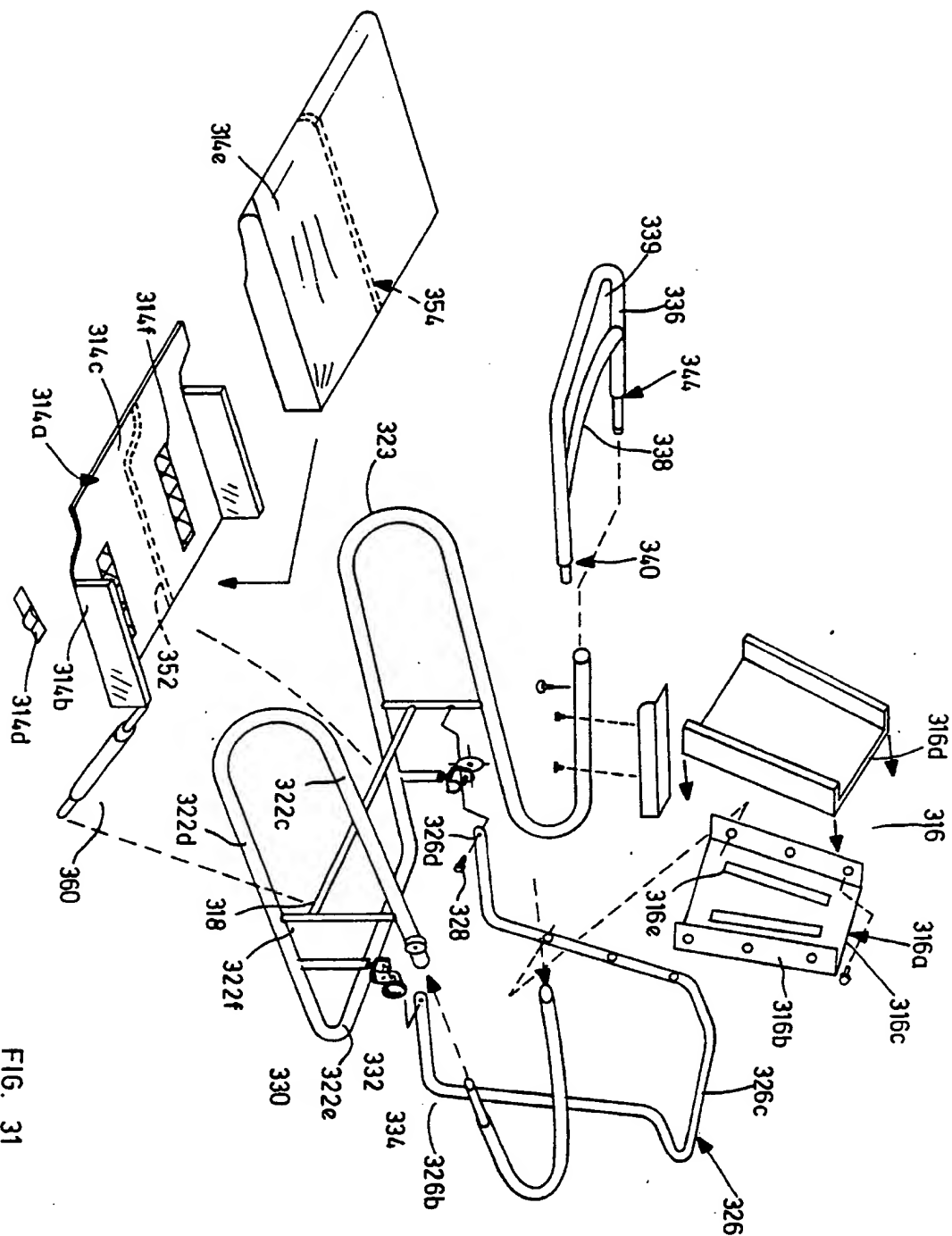


FIG. 31

SUBSTITUTE SHEET

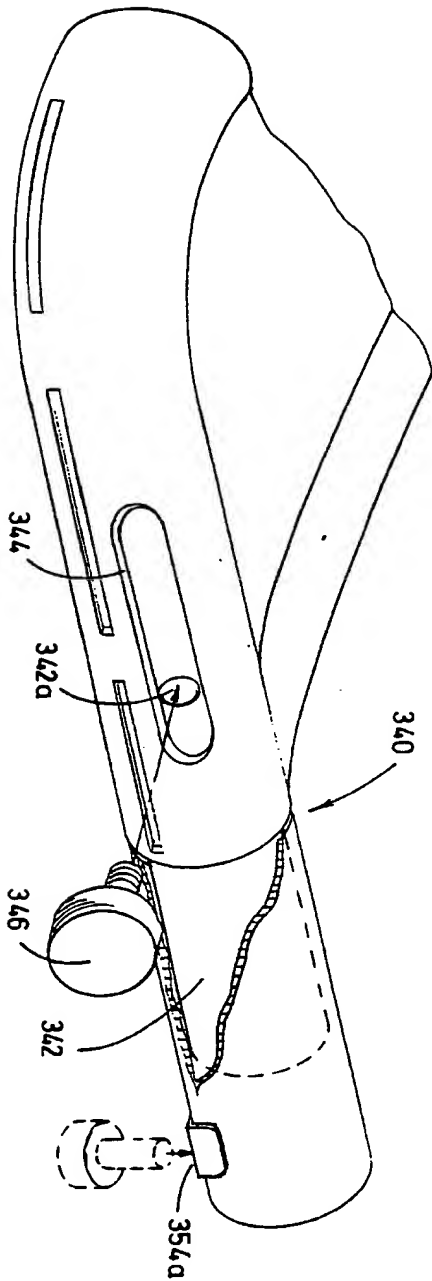


FIG. 32

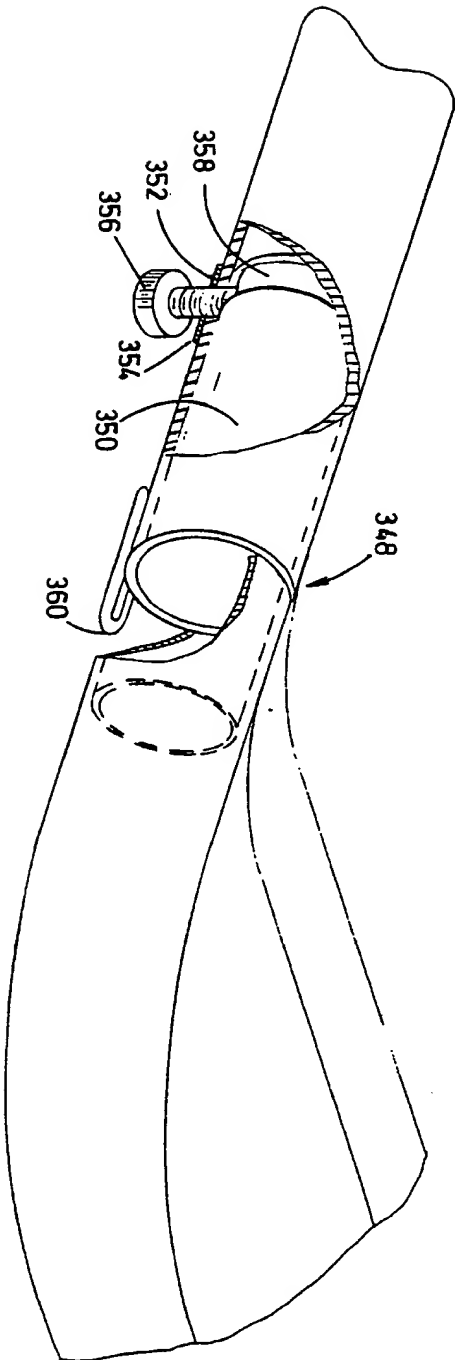


FIG. 33

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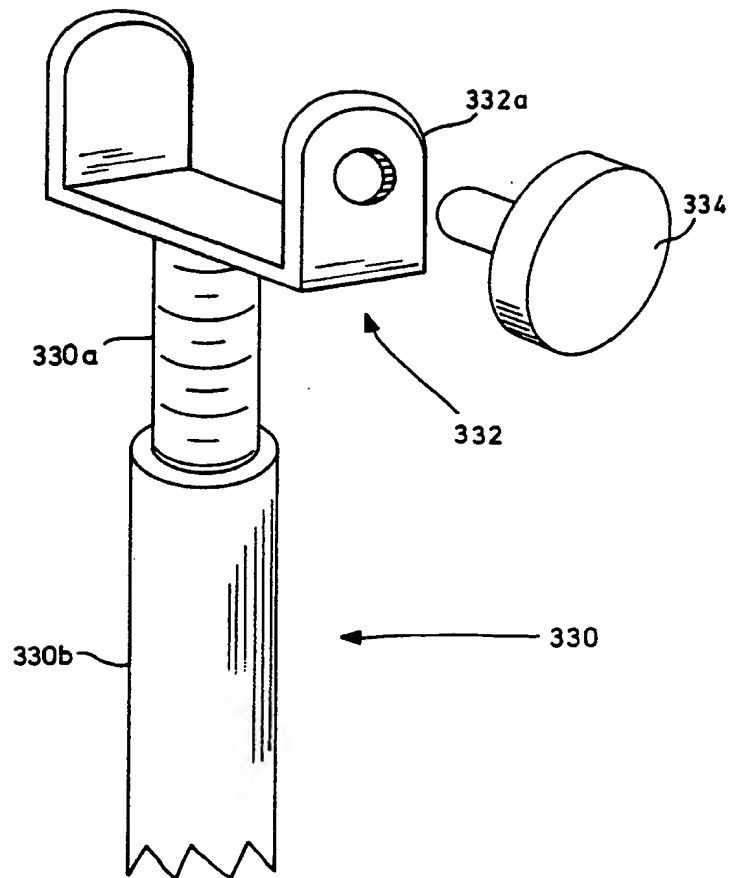


FIG. 34

SUBSTITUTE SHEET

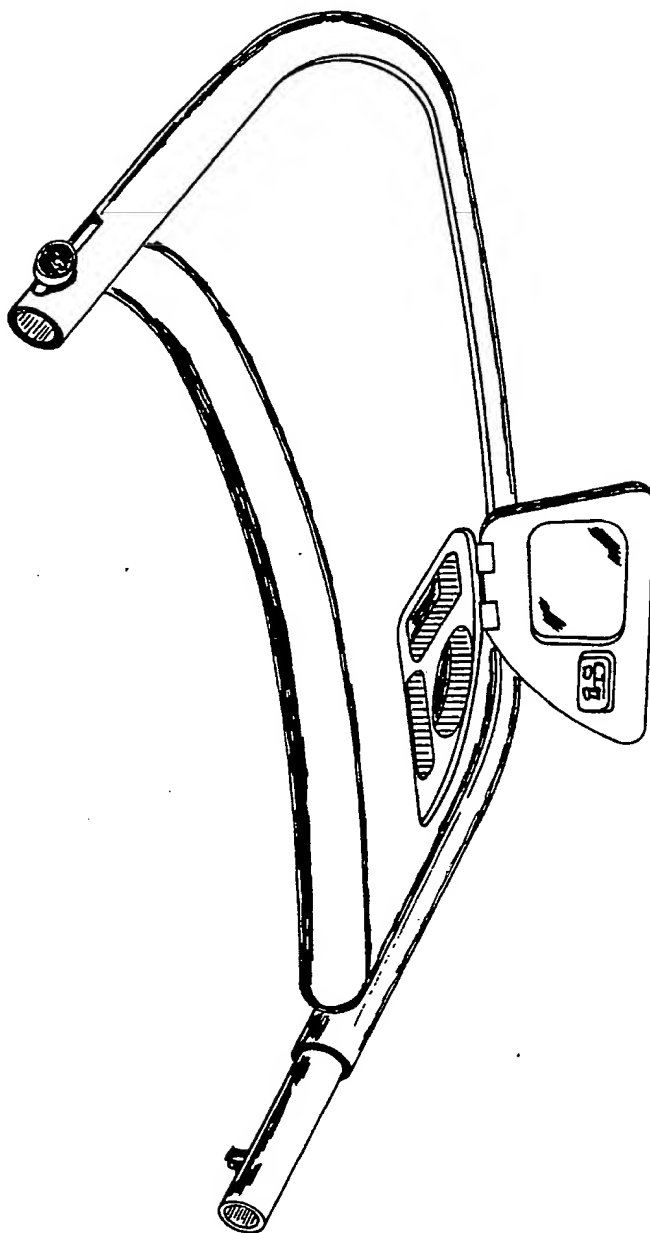


FIG. 35

SUBSTITUTE SHEET

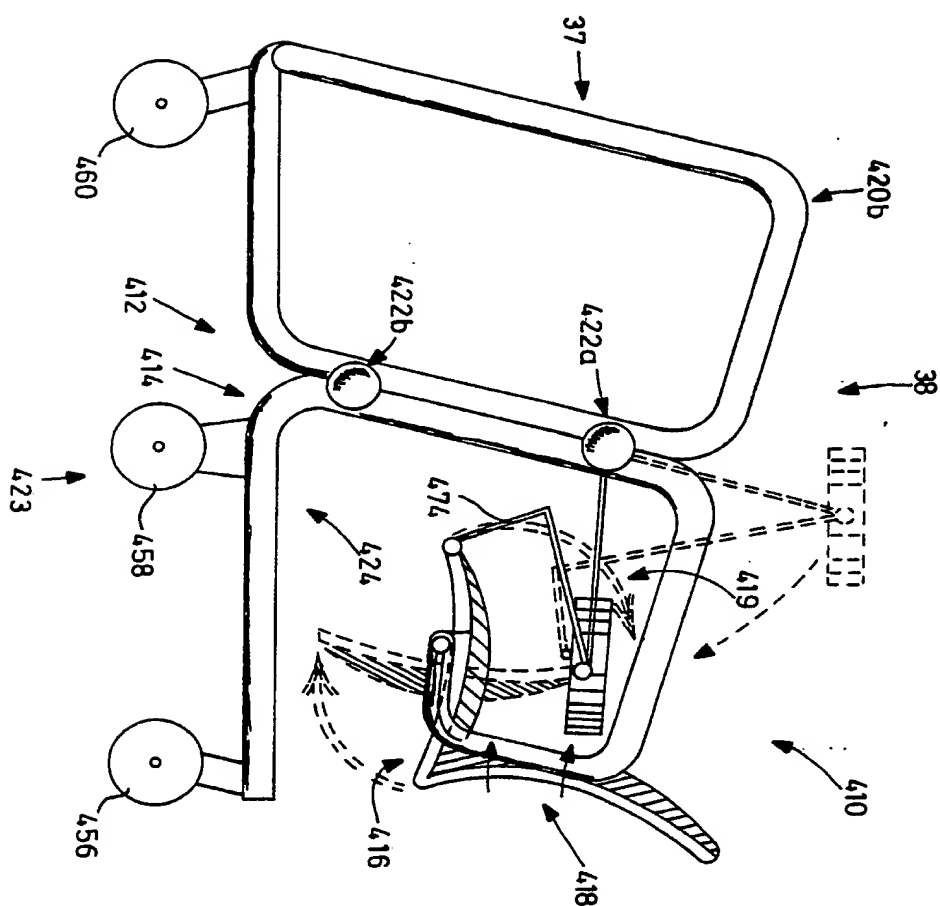


FIG. 36

SUBSTITUTE SHEET

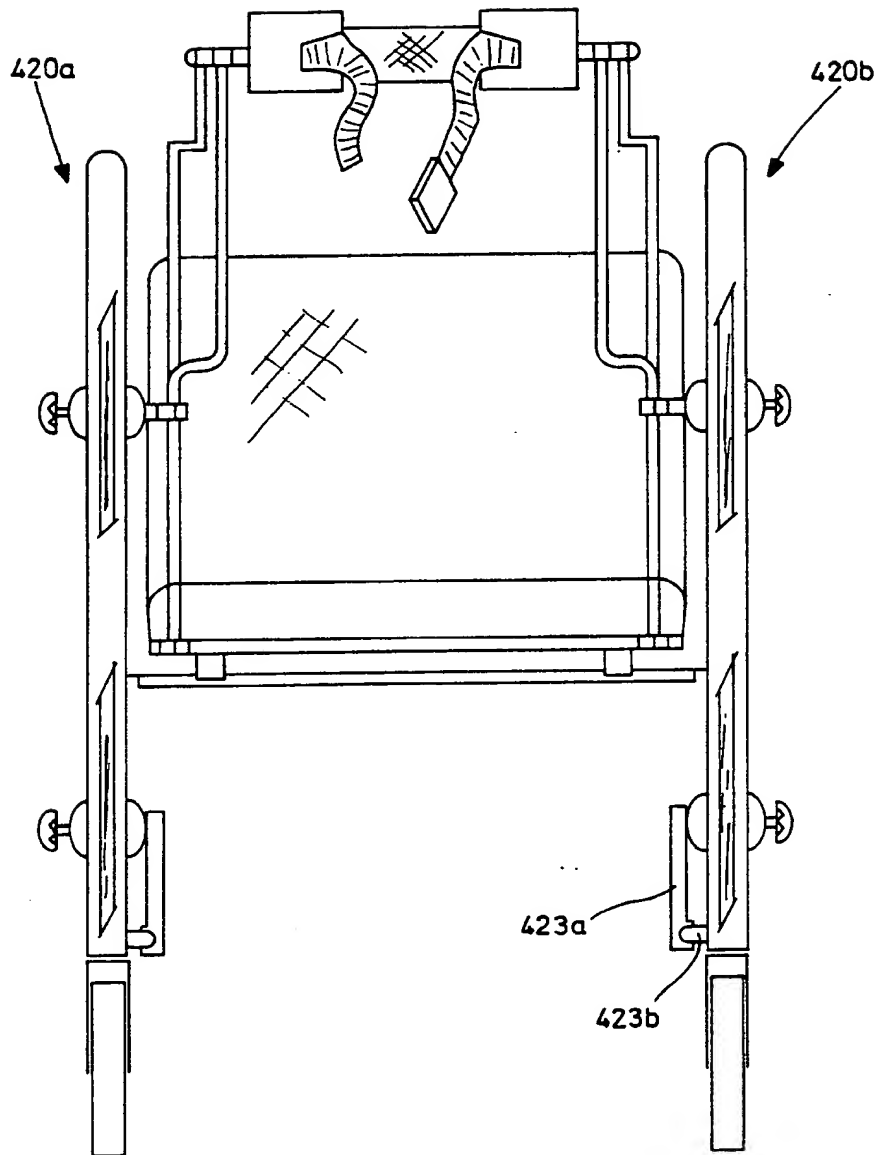


FIG. 37

**SUBSTITUTE SHEET**



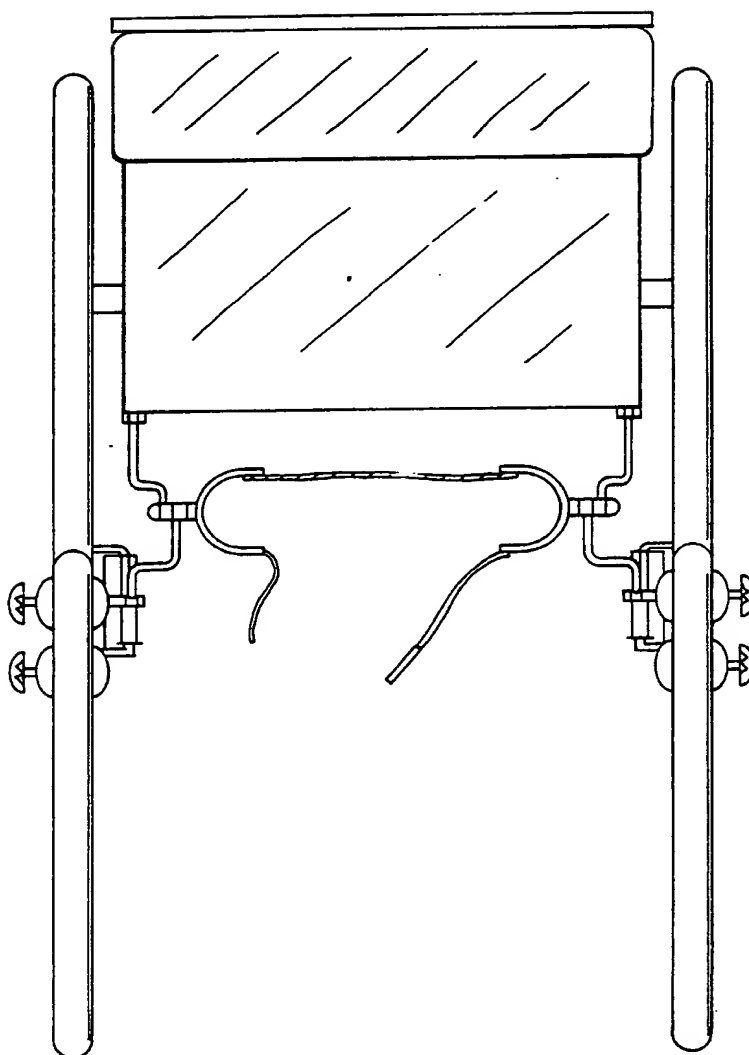


FIG. 38

SUBSTITUTE SHEET

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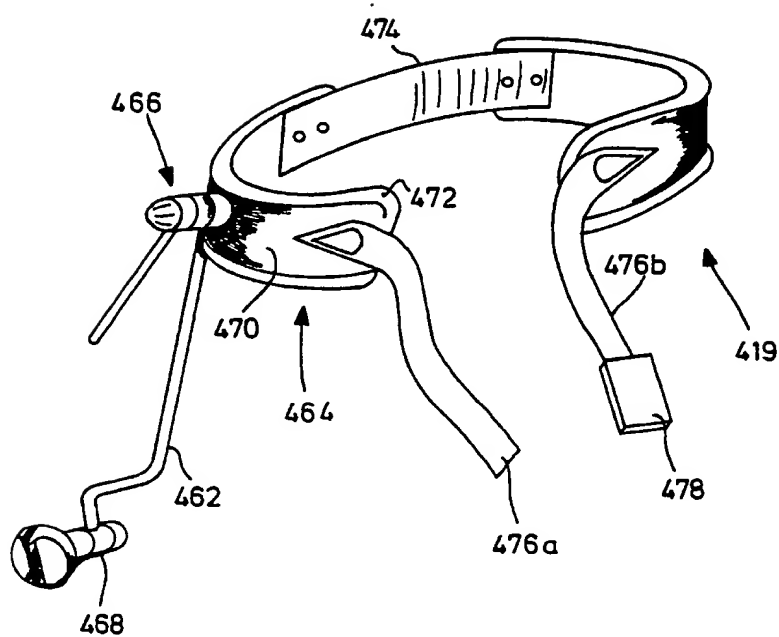


FIG. 39

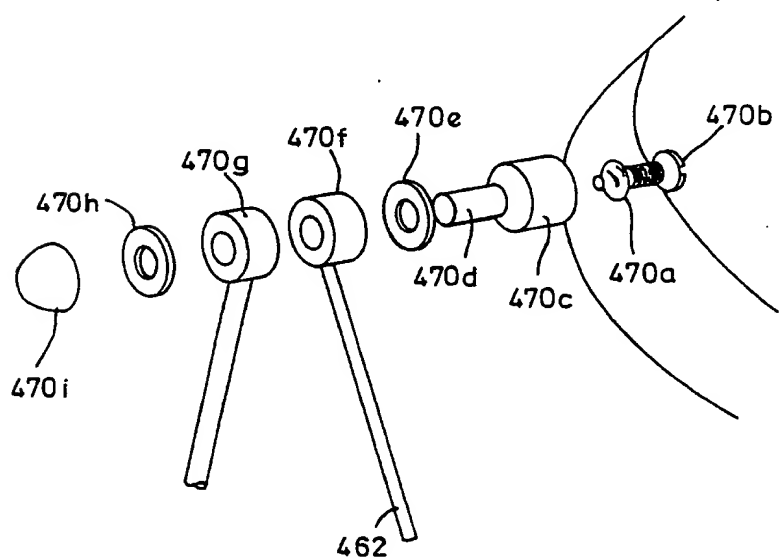


FIG. 40

**SUBSTITUTE SHEET**

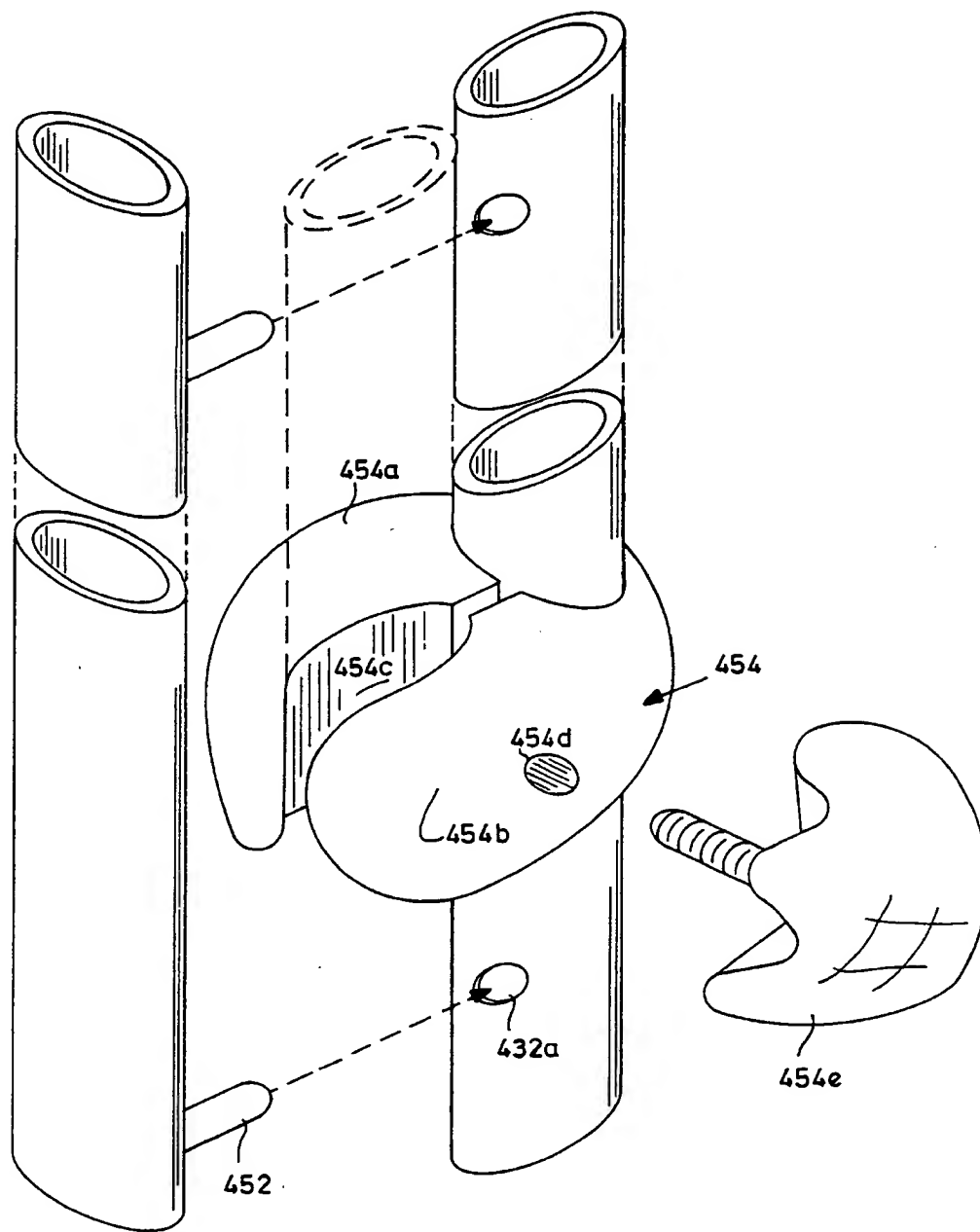


FIG. 41

SUBSTITUTE SHEET

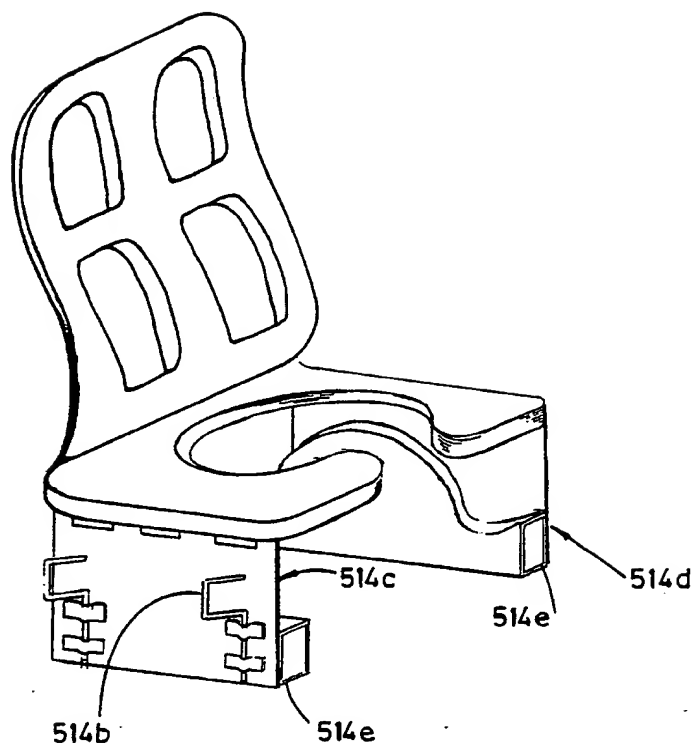


FIG. 45

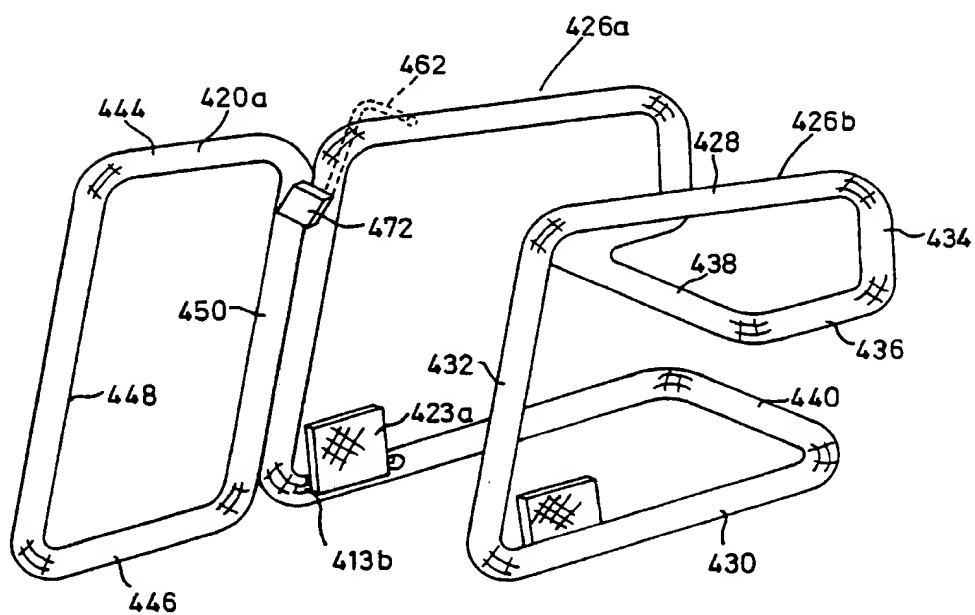


FIG. 42

**SUBSTITUTE SHEET**

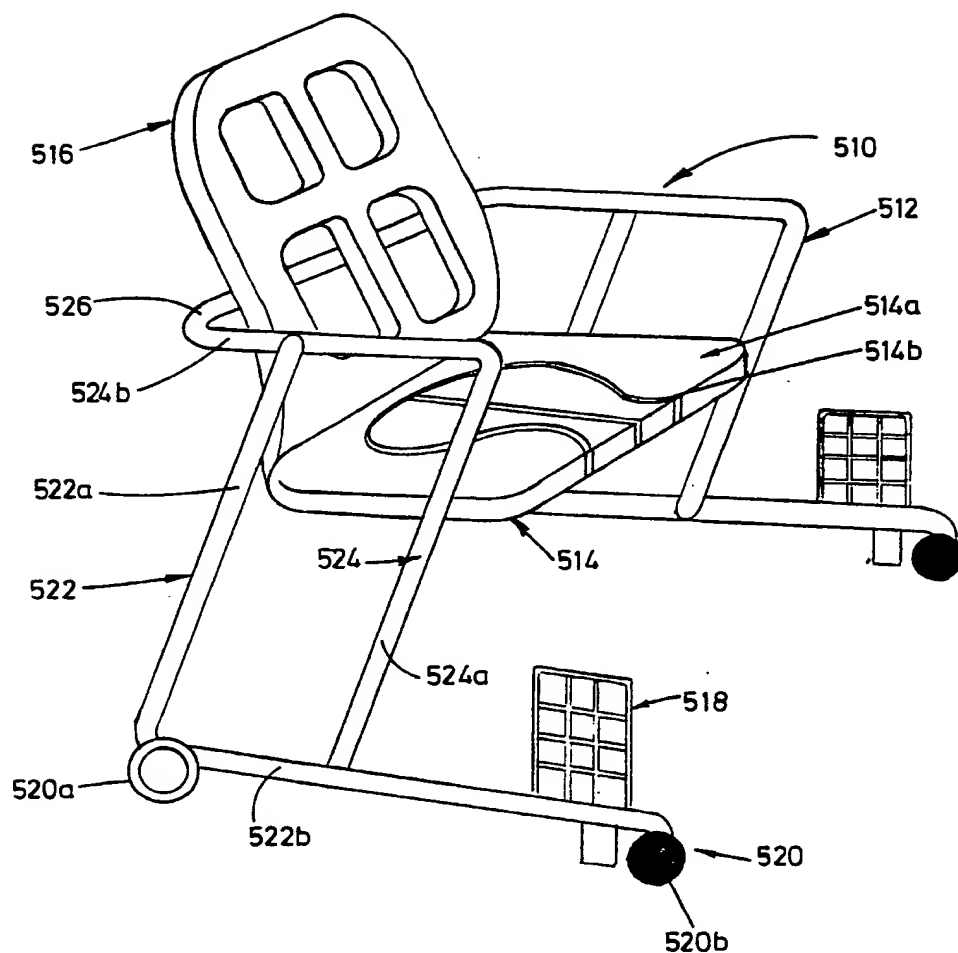


FIG. 43

SUBSTITUTE SHEET

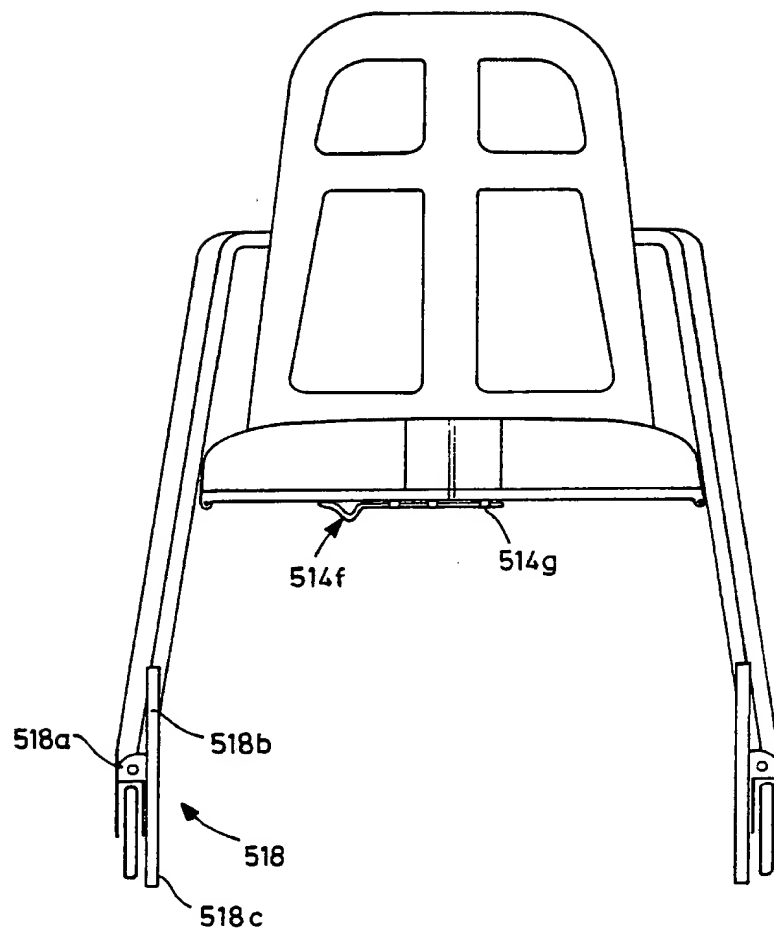



FIG. 44

SUBSTITUTE SHEET

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 87/00507

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) *		
According to International Patent Classification (IPC) or to both National Classification and IPC		
IPC <sup>4</sup> : A 61 G 5/00; A 61 H 3/04		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
IPC <sup>4</sup>	A 61 G A 61 H A 47 D	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched *		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT *</b>		
Category *	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
X	US, A, 3788695 (SALEM) 29 January 1974 see the whole document	1-3, 6, 7, 11, 14-16, 22
	--	
A	US, A, 2630160 (FRIEDMAN) 3 March 1953 see column 2, lines 3-21; figures 2, 5	3, 4, 8
	--	
A	US, A, 2578382 (THOMPSON) 11 December 1951 see claim; figures 1-6	6, 7
	--	
A	GB, A, 2047528 (VESSA LTD) 3 December 1980 see abstract; figure	12
	--	
A	US, A, 3883175 (RODAWAY) 13 May 1975 see abstract; figure 2	13
	--	
A	US, A, 2165700 (GLYNN) 11 July 1939 see page 2, left-hand column, lines 39-71; figures 1-3	17, 38
	--	
A	US, A, 4433869 (PAYNE) 28 February 1984 see column 2, lines 16-19	17, 38
<p>* Special categories of cited documents: <sup>10</sup></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
5th October 1987		19 NOV 1987
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		M. VAN MOL 

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category *	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No
A	GB, A, 832913 (KIRKPATRICK) 21 April 1960 see page 3, lines 48-54; figure --	18
A	GB, A, 2076666 (WHITE CAP ENTERPR. CORP.) 9 December 1981 see page 2, lines 57-74; figure 1 --	21
A	GB, A, 592282 (DUKE) 12 September 1947 see page 2, lines 36-62; figure 5 --	22,23
A	US, A, 1611807 (BERGH) 21 December 1926 see claim; figures --	22,23
A	US, A, 1638426 (WILSON) 9 August 1927 see page 1, lines 84-88; figure 4 --	24
A	GB, A, 1251779 (McKELLOW & HUME LTD) 27 October 1971 see page 2, lines 37-48; figure 1 -----	36,37



# ANNEX TO THE INTERNATIONAL SEARCH REPORT ON

INTERNATIONAL APPLICATION NO. PCT/GB 87/00507 (SA 17941)

This Annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 22/10/87

The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3788695	29/01/74	None	
US-A- 2630160		None	
US-A- 2578382		None	
GB-A- 2047528	03/12/80	GB-A, B 2058683	15/04/81
US-A- 3883175	13/05/75	None	
US-A- 2165700		None	
US-A- 4433869	28/02/84	CA-A- 1162138	14/02/84
GB-A- 832913		None	
GB-A- 2076666	09/12/81	FR-A, B 2483224 DE-A- 3121166 US-A- 4384713	04/12/81 11/03/82 24/05/83
GB-A- 592282		None	
US-A- 1611807		None	
US-A- 1638426		None	
GB-A- 1251779	27/10/71	None	

For more details about this annex :  
see Official Journal of the European Patent Office, No. 12/82